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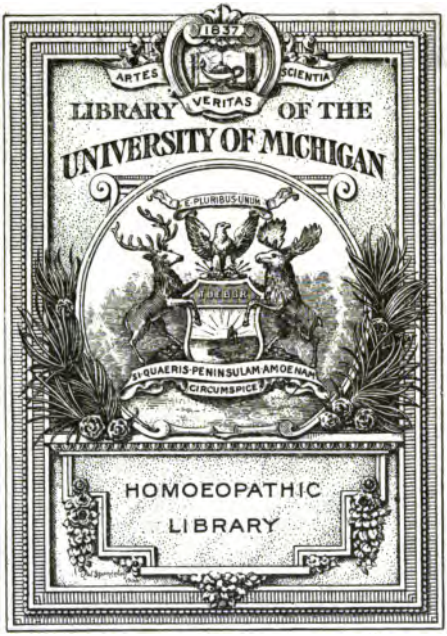
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Treatment of Chronic Leg Ulcers

A Practical Guide to its Symptomatology, Diagnosis and Treatment

By

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PUBLISHED BY
THE INTERNATIONAL JOURNAL OF SURGERY CO.
NEW YORK.
1914.

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THE INTERNATIONAL JOURNAL OF SURGERY Co
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Preface

THE lower extremities are so frequently the site of chronic ulcerative processes that a knowledge of the different varieties of leg ulcers and their treatment according to modern methods should be possessed by every general practitioner. As far as the writer is aware, however, no work exists on this subject, and the physician who desires to familiarize himself with it is constrained to consult the text-books on surgery, in which it is not discussed in sufficient detail to afford complete and adequate information. In the present book an attempt has been made to rectify this defect in medical literature. Impressed with the fact that too little attention is often given to the diagnosis of chronic leg ulcers, the writer has considered the essential diagnostic points of each of the more common varieties before entering into the treatment. To avoid frequent and useless repetitions the various therapeutic measures are described in detail in a special section of the book, while the treatment of the different types of ulcer has been presented in as practical and thorough a manner as possible. The newer methods have received due consideration, and for the

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sake of completeness a brief description of the surgical treatment of enlarged veins has been added. While the work to a large extent reflects the views and personal observations of the writer in hospital and private practice, it has been his earnest aim to omit nothing which might conduce to a more successful management of a common and frequently obstinate class of cases. To Dr. P. J. Rosenheim and Dr. Frank C. Lewis, the author is indebted for valuable assistance in the preparation and publication of this book.

EDWARD ADAMS.

New York, March, 1914.

Chronic Ulcers of the Leg.

GENERAL CONSIDERATIONS.

In the classification of ulcers it must be considered that one or several factors may be concerned in the etiology, and this subject can best be studied by dividing it into:

1. Predisposing causes: (a) general; (b) local.
2. Exciting causes.

I. Predisposing Causes: (a) General, comprising age, sex, occupation and social condition.

Age can hardly be considered as a very important factor, except that old age is accompanied by retrogressive tissue changes, atheroma of the arteries, impaired circulation, etc.; and one would therefore expect the statistics to show a greater proportion of ulcers during the latter decades of life.

As regards *sex,* ulcer is found to be more common in men than in women in the ratio of about three to one. This is probably due to the fact that they are more exposed to traumatism and are more likely to neglect a slight wound, which, with infection, may

undergo ulceration. Also the greater prevalence of syphilis and alcoholism in men may in some measure explain why ulcers are more common among them than among women.

Occupation seems to have little to do with the etiology of ulcer beyond the fact that it may predispose to traumatism or to various forms of infection and that it may prevent cleanliness. It is in this latter element that we have one of the most important factors in the causation of ulceration. The non-specific and non-malignant forms of ulcer are much more common among the poorer classes, among whom lack of means or lack of intelligence as well as untidy habits will allow filth, and with it, of course, infection, to enter a wound the result of a slight abrasion, and the formation of an ulcer is the consequence. In these chronic leg ulcers the role of cleanliness plays a most important part.

Constitutional Diseases. Many of the constitutional diseases, such as diabetes, lithemia, anemia, tuberculosis and syphilis, which lower the vitality of the tissues, and other conditions, such as valvular disease and fatty degeneration of the heart, general obesity and atheroma, which prevent proper circulation, predispose to the formation of ulcers when there is in addition some exciting cause.

(b) *Local Predisposing Causes*:

(1) Interference with the Arterial Circulation. There may be a predisposition to ulceration as a result of embolism which cuts off the nutrition of the part, or the embolus may be infected and thus cause the formation of an abscess which if superficial may result in the development of an ulcer. Atheroma of the blood vessels by interfering with nutrition may also act as a local cause. Certain vasomotor disturbances such as occur in frost-bite, chronic ergotism and Raynaud's disease may produce small areas of localized gangrene which subsequently become the seat of an ulcer.

(2) Interference with the Venous Circulation Varicose Veins. When edema results from interference with the return of venous blood from a part it is obvious that such a condition will predispose to ulceration. The exact relation of varicose veins to the formation of ulcers is, however, a matter of dispute, since there are many people who have varicose veins even to a severe degree and who never suffer from an ulcer. Schrider tried to prove that both are the result of a gouty diathesis. Quenu found a neuritis secondary to the varicose veins and considers the formation of the ulcer to be due to trophic disturbance. The one condi-

tion which has a direct bearing on this relationship is phlebitis. Where phlebitis and periphlebitis occur, especially in the smaller venous radicles, small abscesses often form, the adjacent skin becomes involved, and an ulcer results; or the rupture of the diseased wall of one of the small veins may, in the case of a person of uncleanly habits, readily prove the point of entrance of infection, and then, under the favoring influence of an impaired circulation and poor nutrition of the part, such a rupture most frequently ends in the formation of an ulcer.

(3) Interference with the Lymphatic Circulation. Occasionally in the treatment of extensive cellulitis it is found necessary to make deep incisions, and the contraction of resulting scar tissue may interfere with the lymphatic flow and give rise to stasis and thickening of the part. Under such circumstances ulcers of the leg very frequently occur.

(4) Trophic Changes. Perforating ulcer of the foot is a frequent complication of tabes dorsalis. Also myelitis, peripheral neuritis and other pathological conditions of the nervous system may either through trophic changes or by reason of impaired sensation bear a direct relationship to ulcerative processes.

II. Exciting Causes: (1) *Traumatism.* One of

the most frequent causes of ulcer is an injury of one kind or another. Its degree may, of course, vary greatly, and whether or not it will produce an ulcer depends on one or more of the predisposing causes already mentioned. (2) *Infection.* As has already been mentioned, infection by any of the staphylococcus or streptococcus group of organisms as well as by the tubercle bacillus or spirochæta pallida will produce ulcers, and in syphilis it is usually in the tertiary stage, with broken down gummata, that the typical, specific, punched-out ulcers are found. Among the various other forms of ulcers met on the lower extremities due to specific infection are those of actinomycosis and blastomycosis. Epitheliomatous and sarcomatous ulcers of the leg are also frequently found.

TREATMENT.

The treatment of chronic ulcers is both *local* and *constitutional.* The latter consists of building up the system by tonics when this is necessary, and in treating those general conditions and diseases which act as direct or predisposing factors in the etiology, such as, for example, gouty diathesis, arteriosclerosis, tabes and diabetes. It is also very important to improve the hygienic surroundings, to administer

mercury and iodides for syphilis, to prescribe cod liver oil, the hypophosphites, fresh air, and a change of climate for tuberculous conditions, and iron and arsenic for anemia, etc., thus making it possible to obtain the best results from the local treatment.

LOCAL TREATMENT.

In considering the subject of local treatment it must be remembered that there are several things which we should seek to accomplish in order to cure the ulcer. These are as follows:

1. The reduction of the inflammation in and about the ulcer.
2. The cleansing and sterilization of the ulcer.
3. The stimulation of the granulations.
4. The relief of congestion and the establishment of a proper blood supply.
5. The promotion of new epithelial growth and cicatrization.
6. The palliative and operative treatment of the varicose veins.
7. The treatment of complications of the ulcer.

1. Reduction of Inflammation. Very frequently when the case comes under the care of the surgeon the ulcer and the surrounding tissues are in a state of considerable inflammation and cellulitis. For

the reductiton of this inflammation and the relief of pain moist dressings are the most effective form of treatment because: (1) They are aseptic; (2) they permit free drainage; (3) no new granulations are disturbed in changing the dressing. A great many different solutions are used and among them are: (a) Sterile water; (b) ordinary saline solution, a teaspoonful of ordinary salt to a pint of water; (c) saturated solution of boric acid prepared by dissolving a teaspoonful of boric acid powder in a pint of water; (d) Thiersch solution prepared by dissolving 15 grains of salicylic acid and 90 grains of boric acid in a pint of water; (e) Burow's solution, or a solution of aluminum acetate prepared by dissolving 40 grains of alum and 200 grains of lead acetate in a pint of water; (f) a 2 per cent. solution of carbolic acid; (g) a solution of bichloride of mercury varying in strength from 1 to 5000 to 1 to 10,000; (h) a 2 per cent. solution of creolin or lysol; (i) the U. S. P. lead and opium wash; (j) an aqueous solution of ichthyol varying from 5 to 50 per cent., according to the indication; (k) the black wash which is made by dissolving 64 grains of calomel in a pint of lime water; and (l) the white wash which is prepared by mixing zinc oxide 2 drams, liquor plumbi subacetatis 3 drams,

glycerine 4 ounces, and liquor calcis 4 ounces.

Any of the above solutions applied on a thick gauze compress, kept moist and cool, acts admirably for the reduction of inflammation. The permanent bath consisting of clean or sterile water acts in the same manner, but it has no advantages over the wet dressings except in cases of large ulcers, or where there is a profuse discharge.

2. Cleansing and Sterilization of the Ulcer. Before healthy granulations can form the removal of sloughs and the cleansing of the base must be accomplished as thoroughly as possible. Many means towards this end may be effective. A one-half to 2 per cent. creolin or lysol emulsion is very useful for those dirty ulcers from which a profuse foul discharge escapes. A one per cent. solution of formalin is of great value for smaller ulcers, especially those due to tuberculous disease. The destruction and removal of the sloughs may be hastened by cauterization with the solid stick of nitrate of silver and the application of iodoform or napthalin powder, particularly the latter. The use of certain ferments such as brewers' yeast, papoid, caroid or protonuclein may help to clean up a chronic ulcer. The most frequent means employed for the cleansing and sterilization of the ulcer pre-

vious to the application of some stimulating dressing is washing the leg with tincture of green soap and water and shaving the part. Peroxide of hydrogen can next be used, then some sulphuric ether, and finally 95 per cent. alcohol. Where there is an accompanying eczematous condition the scales can best be removed by benzine.

3. Stimulation of the Granulations. Having reduced the inflammation and succeeded in cleansing the ulcer, the next thing to consider is the means by which granulations may be stimulated. This may be accomplished by applications in the form of powders, solutions, ointments and grafts. Of powders the following may be used: Boric acid, dermatol, calomel, aristol, orthoform, iodoform, bismuth subnitrate, bismuth subgallate, zinc oxide, alum, lycopodium, and many others. Of solutions one may resort to silver nitrate in various strengths, zinc and copper sulphate, potassium permanganate, ichythol, formalin, balsam of Peru and many others. Of ointments, zinc oxide, boric acid, ichythol, mercury, balsam of Peru, Lassar's paste, salicylic acid and scarlet-red may be employed. All of these drugs have their advocate, and on several in particular I shall dwell at length. One of the oldest as well as the best is balsam of Peru, which has a

powerful effect in increasing the growth of granulations, but often after this has occurred the granulations are apt to become exuberant with little tendency to cicatrization.

CHALK OINTMENT.

An ointment containing a very large quantity of prepared chalk forms the best means for producing an artificial crust. The earthy matter must be in a much greater proportion than is present in any ointment of the pharmacopeia. The ointment referred to consists of 16 ounces of chalk and 12 ounces of lard. The best way of preparing it is not by rubbing the chalk with the lard, but having melted the lard in any convenient vessel over a slow fire, then add gradually the chalk, previously reduced to a fine powder. They should be stirred and thoroughly mixed until nearly cold and then the ointment is ready for use. A much more homogeneous compound is thus obtained than could possibly be procured by simple admixture or trituration, since the materials are more intimately blended together. The advantages of this ointment are as follows: (a) It very rarely produces pain and generally much ease and comfort. The great predominance of alkali prevents the lard from becoming

rancid and so producing irritation. (b) When the lard becomes melted by the heat of the part and absorbed by the bandage, the chalk is disengaged and a portion of it combines with the secretion from the ulcer. The secretion is often extremely acrid and excoriates the neighboring skin, but when united with the chalk it is converted into a neutral unirritating compound. (c) This forms an incrustation which is first deposited on the surrounding skin, then on the margin, and finally on the surface of the ulcer, being necessarily produced in a very gradual manner. It is only when the secretion has considerably diminished in quantity that a layer is deposited on the center of the ulcer; but the covering which is provided on the edges protects them completely from irritation. (d) Little disturbance of the dressing is necessary. At first the quantity of the discharge may require its frequent removal, but in a little while this will be wholly unneeded, and our object should be to maintain the mechanical integrity of the chalky incrustation. All fomentation of the ulcer is obviously highly prejudicial.

SCARLET RED OINTMENT.

Another ointment which gives splendid results in promoting the stimulation of the granulations

is one containing scarlet-red. This to my mind is the best of all that are used. Scarlet-red is an anilin dye, being chemically a sodium salt of a disulphonic acid derivative. Scarlet-red (Biebrich) was originally prepared as a dye for wool and silk, and is so named because of the fact that it was first manufactured in the town of Biebrich. It was not until 1906 that Fischer of Bonn made known his observations on its use as a therapeutic agent. In 1907 Schmieden first employed scarlet-red in the form of an ointment of 8 per cent. strength, alternating with a bland ointment every twenty-four hours, because he found the former too irritating. After extensive tests scarlet-red ointment is now used only in strengths varying from one-half per cent. to 5 per cent., for the latter has proved to be as strong as is necessary. When applied to granulating surfaces scarlet-red is sometimes absorbed in sufficient amount to color the urine a bright red. Its application to ulcers of the leg causes healing not by the formation of scar tissue, but in every case by producing a high grade of normal skin, which can be demonstrated by sections and very soon becomes freely movable on the underlying tissue. The return of sensation in the healed area takes place from the periphery inward, instead of upward from

the underlying tissue, and in the dark races the deposit of pigment comes from both sources.

Scarlet-red ointment should be applied in the following manner, either one of two formulas being used: Scarlet-red (Medicinal Biebrich), 75 grains, unguent. zinci oxidi, q. s. ad. 3 oz.; or scarlet-red, 15 grains, unguent. acidi borici, q. s. ad. 1 oz. The 5 per cent. ointment is to be preferred, especially when there is a marked eczematous condition accompanying the ulcer. After thorough cleansing of the ulcer, as previously described, the ointment should be applied in a thin layer over its entire surface on a piece of sterile gauze, and over this an ordinary dry sterile dressing. If the ointment is applied too thickly it may cause granulation tissue to break down, and for that reason it should be spread in a thin layer upon the ulcer or its edges. Usually the dressing should be left undisturbed from twenty-four to forty-eight hours, then reapplied as the indications warrant. The patient should be informed of the fact that the dressings will be stained red, so as to forestall unnecessary alarm due to the belief that a hemorrhage has occurred. He should also be apprised of the fact that stains on the linen are hard to eradicate. In removing the dressing, if it is adherent to the

granulations, some hydrogen of peroxide should be used to loosen it. The skin around the ulcer is best cleansed by benzine, as this seems to remove all traces of scarlet-red better than any other solution.

TREATMENT.

In regard to the employment of ointments it may be said that their use is generally contraindicated where there is a profuse discharge, as they prevent its absorption by the dressing. It has also been observed that there is often a tendency for the granulations to become soft and flabby under their influence. They are at times very valuable when the discharge is small in amount and also when the ulcer is surrounded by an area of eczema or dermatitis.

When an ulcer is very indolent, the application of the solid stick of nitrate of silver or tincture of iodin or solutions of nitrate of silver, zinc or copper sulphate in strength of one to twenty-five per cent. may, by inducing some inflammatory reaction, hasten granulation.

The application of antiseptic and astringent powders finds its chief use when the discharge is small and when the ulcer will heal under a scab. In pain-

ful ulcers orthoform is of value on account of its analgesic action.

In the majority of cases the best results will be obtained by the use of wet dressings which, while they stimulate the granulations, also absorb the discharge. In addition to those already mentioned, one of the best solutions is "red wash," made up from the following formula: Zinc sulphate, 20 grains, compound tincture of lavender, 30 minims and distilled water to make 8 ounces. This solution has a powerful astringent action and promotes cicatrization especially when there is a tendency for the granulations to become exuberant.

SPONGE GRAFTS.

Various other therapeutic measures have been employed to stimulate the granulations, and among these are the x-ray, Bier's hyperemic treatment, skin grafting and sponge grafts. The last named I have used in over fifty cases with excellent results. The sponge used for this purpose is the small Turkish or surgical sponge, as it is called, and those of a soft, fine, elastic texture with great toughness of fiber are to be preferred. All calcareous particles must be removed and the sponge rendered thoroughly aseptic before it can be applied. For

this purpose it should be first immersed in a solution of dilute hydrochloric acid and allowed to remain there for one hour in order to remove all pieces of lime. It is next washed in cold water, then in hot water with green soap, and after this rinsed in sterile water. After removal from the sterile water it is allowed to dry and sterilized by dry heat. The best results have been obtained by using the sponges dry, and after being cut very thin to fit the size and shape of the ulcer they are placed directly against the granulating surface after it has been cleansed in an aseptic manner. Next some dry sterile gauze is placed directly over the sponge, and finally a firm compression bandage is applied from the base of the toes to the knee. When the ulcer discharges very freely the dressing is changed several times a week, but if there is very little secretion the sponge is allowed to remain on from one to two weeks; at the end of a week or later, when the bandage is removed, the ulcer has entirely healed or is less than one-half of its original size. The sponge acts in a mechanical manner as a support to the new tissue, especially to the capillaries, the meshes of the sponge being filled in by granulation tissue, and as this grows the sponge is absorbed. Being a porous material, in this respect

it imitates the interstices of the fibrinous network in a blood clot or in fibrinous lymph. In addition it is an animal tissue and acts like catgut, being absorbed in time. The great advantage the sponge possesses, however, is that it can be cut to fit any size or shape of an ulcer. Nearly all of the fifty cases were healed within three weeks. The average case required eight dressings. As regards Bier's hyperemia treatment, only the "arterial form" should be employed by means of baking or hot air. The passive venous or obstructive method of hyperemia is indicated only in certain types of ulcer, whereas the arterial form or baking can be used in all cases of leg ulcer. For skin grafting either the method of Thiersch or Reverdin can be employed.

4. Relief of Congestion and Establishment of the Proper Blood Supply. In the case of chronic leg ulcers, especially those associated with varicose veins, it is impossible to effect a cure until the chronic congestion of the limb is relieved and the blood supply of the part approaches the normal. Often all that is necessary is a gauze, muslin or flannel bandage properly applied over the dressing and extending from the ankle to the knee. Martin's rubber bandage, when applied with moderate, even pressure, has for its purpose the relief of con-

gestion, but in a great many cases the rubber has an irritating effect on the skin. When the granulations are almost on a level with the surrounding skin, and also when there is considerable thickening of the edges of the ulcer, the best means of keeping up an even pressure and causing absorption of the thickened margins, as well as hastening the epithelial growth, is to apply zinc oxide adhesive plaster in strips one-half to one inch in width. These strips should overlap to the extent of about one-third of their width, should be evenly and smoothly applied, and should extend about three-fourths of the way around the limb. They should be started about one inch below the ulcer and should run from two to three inches above it.

BANDAGING.

The final stage after the ulcer has been treated consists in the application of the bandage. A bandage possesses advantages over strapping in being less irritating to the skin; in being more quickly put on and taken off; in being more easily removed without disturbing the surface or injuring the margins of the ulcer; and in more completely allowing the formation of the granulations. Equally superior is the bandage to a laced stocking,

as the latter does not properly embrace the foot. The bandage material can be either gauze, muslin or domett flannel. The last I find the best, because this material is thin, yielding and elastic, and yet almost any degree of compression can be exercised with it. In edematous swelling in general the flannel appears very suitable, as it is soft to the skin and accommodates itself to the greater or less distention of the limb arising from the increase or diminution of the fluid. The calorific properties of flannel are useful, since in all structures and organs in which capillary circulation is obstructed the vital heat is reduced below the normal. The bandage should be at least six yards long if required for an ordinary male adult; the width should be from 2 to 3 inches. Every portion of the limb from the toes to the knees should be equally and evenly compressed. Compression is indeed of such absolute importance in the treatment of chronic leg ulcers that without it everything else will be comparatively ineffectual. And this being so, the rapidity and completeness of the cure will depend very much on the manner in which the bandage is employed. Without practice it is not easy to apply a bandage properly to the leg; and probably this difficulty is the chief reason why preference is often given to

adhesive plaster, as this sticks and remains wherever it is put. The blistering and excoriation often produced by strapping and the time consumed in its application are sufficient reasons for acquiring skill in the art of bandaging — an art whose comforts and advantages are appreciated by the patient.

Before use the bandage should be rolled up very tightly, so that it may be grasped easily and held in the hand firmly without slipping. In putting it on unwind only that portion which is being applied to the limb; if it be loose in the hand or if a considerable piece be unrolled at a time, it cannot be applied smoothly or firmly. The bandage should always be carried up to the knee, even if the ulcer be seated on the lower part of the leg or on the foot itself, as the object in its application is not merely to cover and flatten the ulcer, but also to support the vessels of the limb. To place only a short bandage over the ulcer itself is to forfeit some of the chief advantages of this measure. Moreover, if the bandage be discontinued on any part of the leg it is liable to become lose and fall down. It is desirable also that the patient should not wear a garter above the bandage, as anything unequally tight in the course of the veins is calculated to obstruct the free passages of the blood. Usually it is not necessary to

carry the bandage above the knee, for no matter how varicose the veins of the thigh may be, yet when the condition of the vessels of the leg is bettered by compression, those higher up seldom fail to participate in the improvement. Now and then, however, the veins of the thigh are very much distended, or there is ulceration of the skin above the knee; in either case the bandage may be required to go above the joint and up the thigh. Under these circumstances it will be found convenient to use two bandages; the second to begin below the knee where the first leaves off. The upper bandage should be passed over the knee in the usual figure-of-eight manner. It cannot be made to exert much pressure, but it keeps on the necessary dressings.

The firmness with which the bandage is put on is, of course, chiefly for the purpose of gaining the good effects of compression on the structures beneath, but besides it contributes very much to making the bandage remain in its position when once applied. Encircle the limb with it in a loose, careless manner and it will fall down almost directly the patient begins to walk about. Tight bandaging is extremely well borne if performed in a complete and methodical manner, beginning at the lowest portion of the foot around the first joints of the

toes and ending just below the knee. When pressure excites uneasiness it is either because the bandage is put on irregularly or because the lowest part of the limb is not included in its folds.

The proper application of the bandage is of such great importance, especially in the treatment of varicose ulcers of the leg, that it should, when possible, always be done by the surgeon himself. It is difficult for the most skilled layman to put a bandage on his own limb. The surgeon who will not take the trouble to apply it himself should not undertake the treatment of an ulcer of the leg. The real practical difficulty lies with those patients who live at a distance from the doctor and who can only visit him once a week or at ten days' intervals. These must be taught to dress and bandage the limb, and generally some friend or relative will learn to superintend the details.

The length of time which elapses before the bandage and dressings are removed and reapplied must necessarily be determined by the circumstances of each case. When the ulcer is very extensive and the discharge proportionately great it may be advisable to dress the leg every day at the beginning of the treatment. Generally speaking, an ulcer of the leg is disturbed too often. To take off a dressing and put

on another, even though done with the greatest care, interrupts the healing process and the natural steps to cure. Let the dressing remain on until some uneasiness points to the propriety of taking it off for the purpose of allowing the escape of the discharge. Delay the removal of the dressings as long as possible without carrying the forbearance too far. Avoid the extremes of meddling too soon and of waiting too long. Taking the average case, I find that an interval of three days may in general be safely permitted.

MARTIN'S BANDAGE.

Whenever possible the patient should be kept in bed or, at least, in the recumbent position with the leg elevated, but when circumstances do not permit of this the veins can be supported in various ways. Elastic stockings are excellent, but expensive and not durable. Bandages of rubber cloth, or woven bandages rendered elastic by the character of the mesh, or Martin's plain rubber bandage may be employed. The last named is put on smoothly but not too tightly, for in walking the leg swells, so that a uniform pressure is established. As the rubber prevents evaporation it acts like a wet compress, stimulating the granulations, but very often produc-

ing eczema around the ulcer. The rubber bandage should be washed carefully at night with soap and cold water and must be kept clean. In one patient a firm elastic stocking of vulcanized rubber will give the greatest ease and comfort, while in another the resulting irritation will prove insupportable. As regards the flannel bandage I have already spoken about it at some length.

UNNA'S PASTE.

The essential feature of ambulatory treatment is a good dressing to prevent congestion, and to my mind Unna's is the ideal one. The paste necessary for the bandage is prepared as follows: First dissolve four parts of the best gelatin in ten parts of water by means of a hot water bath. While the fluid is hot add ten parts of glycerine and four parts of powdered white oxide of zinc; stir briskly until the mixture is cold. Another formula for the paste, and the one I use, consists of the following: White gelatin, 2½ ounces; water, 8 ounces; zinc oxide, 2½ ounces, and glycerine, 4 ounces; prepared as above. The paste should always be melted before use by placing the receptacle in a hot water bath or an ordinary copper sterilizer such as that employed for boiling instruments. A small tin

THE APPLICATION OF UNNA'S PASTE.

can be used, and a piece of paste about four inches square is cut into fine pieces and put in the can. This is placed in the sterilizer, into which is poured water to a depth of about two inches, so that the can is but slightly immersed. No top should be placed on the can. An ordinary stove or gas range can be used for heating purposes. A very important fact to remember is that no water is to be put into the can with the paste.

The ulcer and leg are next cleaned in the manner heretofore described, and after the paste has been thoroughly melted it is applied as hot as the patient can comfortably tolerate it by means of an ordinary small paintbrush from the base of the toes to the knee. Then a layer of gauze bandage (two to three inches in width according to the limb) is applied, then a layer of paste, and in this manner two or three thicknesses of bandage are used, depending on the case. In thin people it is necessary to use only one or two layers of bandage, whereas in stout persons several layers may be required. After the last application of the paste some non-absorbent cotton is spread on the bandage, giving it the so-called "moleskin" plaster finish. Another way of finishing the dressing is to dust some ordinary talcum powder on the

last layer of the paste, giving the bandage the appearance of a plaster-of-Paris dressing. If there is considerable discharge from the ulcer a window can be cut out, and thus provide for the drainage of the secretions. The length of time this dressing should be left on depends on a number of conditions, especially the amount of secretion and whether the patient has to remain on his feet very much. Ordinarily the bandage can remain on for one week, but indications may be such that it need not be removed sooner than the tenth day, and in some instances it can be kept on for three or four weeks. To remove it an ordinary bandage scissors is used to cut the dressing, and it peels off without disturbing any of the granulations on the ulcer.

5. Promotion of New Epithelial Growth and Cicatrization. The value of nitrate of silver and red wash as stimulants of the healing process has already been mentioned. They are also of value in producing cicatrization and promoting the covering of new epithelium over the ulcer. If the solid stick of nitrate of silver be applied very lightly to the edges just inside the pale bluish line of advancing epithelium, so as to produce a white film on the surface, this slight cauterization will be found to aid in strengthening and cornifying the new, delicate and

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previously invisible epithelial cells and preventing them from being washed away by the discharge from the ulcer. The solid stick of nitrate of silver is also of benefit in destroying the exuberant granulations which project above the surface of the surrounding skin; and often by piercing these flabby granulations in several places with the solid stick held perpendicular to the surface cicatrization is hastened. After the granulations are level with the surrounding skin the covering of the ulcer with new epithelium is hastened by the application of some smooth surface along which the epithelium can spread. For this purpose zinc oxide plaster or some thin rubber may be used.

In some old chronic cases healing is prevented by the fact that the base of the ulcer cannot contract owing to its being bound down by fibrous scar tissue. This binding down of the base and edges of the ulcer also tends to cut off the blood supply, and therefore in this additional manner healing is hindered. For the relief of this condition a number of procedures have been devised. Mattress sutures introduced through the normal skin beyond the edges of the ulcer and passing beneath it, out through the skin on the other side, is one method. By tightening these sutures over a button or metal

plate the ulcer can be lifted from the underlying tissues. Another method called starring of the ulcer consists in a series of radiating incisions through the base and edges of the ulcer, the part from which the incisions radiated corresponding with its center. In this and in the following operations in order to obtain a favorable result it is necessary that the incisions pass completely through the cicatrical tissue which forms the base and edges of the ulcer into normal tissue. "Cross-hatching" of the base of the ulcer by means of a series of incisions at right angles to one another, and at a distance of about one-half inch apart, is often of value in aiding the healing of a chronic ulcer, the continued existence of which and failure to heal having been due to its thickened, adherent base and edges. Circumcision of a chronic ulcer consists in making a circular incision around it through the normal skin. A modification of this method consists in making a series of overlapping, short, curved incisions surrounding the ulcer instead of a single circular incision. In these last two methods it is necessary that the incisions be made through normal skin, and that the wounds be made to gape, if necessary, by packing them with gauze.

When an ulcer is of considerable size it is often

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impossible to secure healing even by these methods. It may for a time appear as if it were going to heal, and a pale blue line of newly formed epithelium may spread out from the edges, but instead of the epithelium continuing its progress, at a subsequent dressing it will be found to have melted away. In these cases, as well as in those in which the size of the ulcer would necessitate a long delay for a cure or in which the subsequent contraction of the scar would produce deformity, skin grafting, skin transportation, or some form of flap operation is indicated.

SKIN GRAFTING TO OBTAIN A SOUND SCAR.

A very important object in the treatment of all ulcers is to obtain a sound scar. In ulcers affecting the lower extremity in elderly people, the scar resulting from spontaneous healing is weak and readily breaks down if the patient does much standing or walking. The patient is therefore frequently obliged to give up work in order to get the ulcer re-healed, or must be content to employ means which merely prevent its extension and relieve some of the discomfort. When the best possible scar is desired, and when it is important to avoid marked

contraction, it is necessary to adopt some method of skin-grafting. There are three plans by which rapid healing of an ulcer may be brought about: Réverdin's epidermis grafting, Thiersch skin grafting, and the use of the whole thickness of the skin.

(a) Reverdin's Method. In this procedure small thin portions of the superficial layer of the skin are snipped off with a curved scissors. Pieces about the size of a hemp seed are planted on the surface of the granulations at short distances from one another. Epidermic growth occurs from each of these little points, and the result is that numerous small islands of epithelium form over the surface of the ulcer. If the grafts be close enough together and the conditions be favorable to healing, these islands soon coalesce and thus rapid cicatrization is obtained. The grafts should not be too far apart, because they appear to have only a limited power of reproduction.

(b) With a view to obtaining a sounder scar, thicker and more extensive portions of the skin must be taken and the grafts must be applied close together. There are two ways of doing this; either by using the whole thickness of the skin or by employing Thiersch's method, in which about half the thickness of the skin is shaved off. We need not de-

scribe the procedure where the whole thickness of the skin is employed, partly because the results are not satisfactory and partly because all the conditions for which it was introduced are better fulfilled by Thiersch's method. Skin grafts may be taken either from the patient himself or from a second individual. When the patient is very debilitated, the cutaneous epithelium shares in the general malnutrition and under these circumstances a graft from a healthy subject might succeed better than one taken from the patient.

(c) Thiersch's Method. In employing this method the skin which is to be used for the grafting must first be shaved and disinfected in the usual manner (as described before). The presence of hairs on the grafts seems to interfere materially with their union.

Preparation of the Ulcer. (*a*) *Preliminary.* It is of no use to graft a sore which is actually ulcerating; it must be brought into a healthy condition, and healing must have commenced before transplantation is likely to be successful. The best criterion that healing is taking place is the presence, at the edges, of the dry red line which indicates recently formed epithelium. Some surgeons wait for a considerably longer time before grafting in order to get

a firm layer of granulations, but experience shows that it may be safely resorted to as soon as healing begins around the edge. A second essential is that the ulcer shall be clean. If the discharges be septic the graft, which is after all merely a piece of dying tissue, will become impregnated with decomposing pus and may rapidly become loosened, die, and undergo decomposition. The methods of rendering the ulcer aseptic have already been described.

(*b*) *Operative.* The following is the method of procedure: After the patient has been placed under an anesthetic the granulations over the whole surface of the ulcer are forcibly scrubbed off with a firm nail brush, or are evenly scraped away, taking care, however, to remove only the soft layer of granulations and not to go through the deeper one of newly formed fibrous tissue into the fat. A surface is thus left which is smooth, highly vascular, and firm, and which consists of the deeper layers of granulation tissue that have already become organized into fibrous tissue. In cases of ulcer of the leg it is also advisable to remove those portions of the edge which have already become covered with new epithelium. If the transplantation be limited to the parts actually unhealed, the result is

disappointing as a rule; for while the part grafted remains sound, the margin where spontaneous healing had occurred is apt to break down, and thus a narrow line of ulceration appears at the edge of the ulcer. After the layer of granulations has been removed and the newly healed edge of the ulcer has been cut away, the bleeding must be arrested completely before the grafts are applied. The most rapid method is to pour a few drops of adrenalin chloride (1 to 1000) solution over the raw surface, when the oozing ceases immediately. If adrenalin be not at hand the following plan will be found satisfactory: Any spouting vessel is clamped and a large piece of sterilized gauze or thin sheet rubber is applied over the raw surface. Outside this several sponges are placed and a sterilized bandage is bound firmly over them. If the sore be small and an assistant be available he may apply the pressure. Pressure is employed indirectly through the protective in this way, because if it were made directly upon the surface of the wound by means of the sponges bleeding would recommence when the latter were removed, as they stick to the raw surface.

While the bleeding is being arrested the surgeon cuts his skin grafts from any part of the body, as he thinks fit. As a rule they are taken from the front

of the thigh, but the side of the abdomen may be selected. The area from which the grafts are to be cut is disinfected, and the surgeon grasps the limb from behind with his left hand in such a way as to make the skin over the front of the thigh as tense as possible; in doing this he pushes the soft parts well forward so as to make the anterior aspect of the limb as flat as possible. The skin is further put on the stretch vertically by an assistant, who pulls it upwards and downwards. These precautions are important, as without them it is almost impossible to cut a graft of even width. The razor, which should have a very broad blade, is dipped into a boric acid solution and is kept constantly wet with it whilst the grafts are being cut. Unless this be done the graft adheres to the blades and may be either partially or wholly cut through before a sufficient length can be obtained. The razor is made to penetrate through about half the thickness of the skin, and then, by a lateral sawing motion, the grafts are cut as broad and as long as possible. After a little practice it is easy to cut them about two inches in breadth and about four or five inches in length. If one graft be insufficient it is best to slide it off the razor and leave it on the bleeding surface; in this way it is kept warm and moist.

Some surgeons put the graft into warm saline solution, and it is said to then spread out more easily afterwards. Small skin grafts can be cut under local anesthesia.

Application of Grafts. When a sufficient number of grafts have been cut, the bandage, sponges and protective are removed from the raw surface of the ulcer and the grafts are applied to it if the bleeding has stopped, as is generally the case. The raw surface usually has a thin layer of blood-clot upon it, and this should be wiped away. Each graft is lifted with forceps or the fingers and applied with the cut surface downwards, and then is carefully unfolded by means of two probes and stretched evenly over the surface. The grafts should overlap the edges of the skin and also each other, so that no part of the raw surface is left exposed, for granulations always spring up on the uncovered parts and are apt to destroy the grafts in their vicinity; moreover, a thin scar is left at these points which may break down subsequently. The graft is always thinner at its edges than at its center, and it is these thin edges which overlap each other or the margin of the skin; there is no real sloughing of these overlapping portions.

The dressing should be left on the grafted surface

for about five days; in some cases even for a week. If the wound be aseptic no suppuration or decomposition takes place beneath it. Before being removed the dressing should be thoroughly soaked with a 1 in 2500 sublimate solution, for otherwise it may stick at the edge and adhere to the graft, which may thus be peeled off unless great care is taken. The parts should be gently cleansed with the same solution and a dressing similar to that put on originally should be employed for about another week. At the end of that time the grafts are fairly firmly adherent and then a 5 per cent. boric acid ointment is the best application. It will be found that even at the first dressings the grafts present a pink color and are adherent to the deeper surface, though they are still readily detachable. In the course of about a week the old cuticle peels off, but no raw surface is left. Later on, there is a great tendency to the formation of new epithelium, cornification, and drying-up, and it is in avoiding the latter condition that ointments are so useful. In fact, until the scar is absolutely sound, it is well to keep the surface covered with some greasy application, the best being the five per cent. boric ointment. For many months the grafted surface is likely to scale or crack, and this might prove a

starting-point for the occurrence of sepsis which would cause the newly grafted area to slough. It is important to keep the scar as supple as possible, and therefore it should be constantly annointed with cold-cream, vaselin, or lanolin. Grafted surfaces upon the face, however, do not manifest this tendency for any length of time.

Time Required for Cure. It is important to know when the patient may be allowed to walk about after an ulcer of the leg has been skin-grafted. If he begins too soon, the grafts will almost certainly become detached. That this will be so, is evident from a consideration of the mode by which the adhesion of the grafts takes place. At first they adhere to the surface of the sore simply by means of the effused and coagulated lymph. Cells rapidly spread into this lymph, and in the course of two or three days the space between the graft and the raw surfaces is occupied by a mass of young cells. In this tissue new bloodvessels develop and penetrate into the graft, whilst, at the same time the cells of the latter grow and assist in the development of the young tissue and of the bloodvessels. Thus the graft becomes vascularized; but for a considerable time the tissue between it and the surface of the sore contains many young bloodvessels with deli-

cate walls, and therefore, if the patient stands erect and allows the pressure of the column of blood to tell on these vessels, they rupture and bleeding occurs beneath the graft and leads to its detachment. It requires a long time before the graft is firmly incorporated with the tissue beneath by the development of elastic fibers; indeed, it may be reckoned that this union is not complete until from three to six months have elapsed. The graft will in all probability be destroyed if the patient walks about within three months of the transplantation. Hence, unless that time can be devoted to the treatment, it is not worth while employing skin-grafting for ulcer of the lower limbs. By this, however, it is not implied that it is necessary to keep the patient in bed for the whole time, but merely that the foot must not be allowed to hang down, nor must any weight be borne upon it. At the end of about six weeks the patient may be allowed to get up and lie on a sofa or sit with the leg on another chair, but the limb must not be permitted to hang down. After about three months he may be allowed to get about, but in order to prevent the detachment of the grafts, he should be fitted with a knee-rest and peg on which he walks, the leg projecting out behind him. If possible he should not put his foot to the ground until six months have elapsed.

In cases of sores on other parts of the body, when the erect posture does not cause congestion of the part, the patient may be allowed to walk about after the first three weeks.

Results. The scar which results after skin grafting performed in this manner is of a satisfactory character, and ulcers which have been intractable for years may be closed satisfactorily by this means. In order to obtain anything in the nature of a permanent cure, however, the prescribed period of rest must be adhered to rigidly.

Dangers of Ulcers. The rapid and permanent cure of an ulcer is a matter of great importance; not only is a patient afflicted with it more or less incapacitated from work, but he is liable to various accidents which may permanently cripple him or even lead to his death. To illustrate, when an ulcer is situated over a muscular part, the muscles may become so matted together that the movements of the limb are much interfered with. This is more especially the case if the ulcer lies over tendons; the tendon and tendon-sheath may then become adherent to each other and to the surrounding parts.

Perhaps the most common disabilities resulting from ulcers are those due to the contraction occurring during the efforts at healing. When an ulcer

is situated over a joint, for example, the healing process may lead to so much contraction as to fix the joint permanently in a faulty (usually a flexed) position. Again, when an ulcer surrounds the leg completely, the contraction may be enough to constrict the vessels coming from the parts below, and so cause great and permanent edema and often complete uselessness of the foot. There is also the risk that the veins in the vicinity of an ulceration may become inflamed and an extensive simple or septic phlebitis may follow. A patient with an open sore is subject to all the ordinary septic diseases. more especially erysipelas. Lastly, it may be pointed out that an epithelioma not infrequently develops upon an ulcerated surface of long standing.

6. Palliative and Operative Treatment of the Varicose Veins. The former I have already dwelt upon in discussing the use of the gauze, flannel, muslin, or rubber bandage and Unna's paste. For the technic of the operative treatment of varicose veins I shall refer the reader to the chapter devoted to this subject.

7. Treatment of the Complications of the Ulcer. The chief complications comprise eczema, dermatitis, erysipelas, thrombosis, and phlebitis. These subjects will be discussed in a separate chapter. I

would only emphasize here that after an ulcer has been healed it is always well to instruct the patient in the care of the limb. It is most important that he should know how to keep it clean and dry, and if necessary well powdered with talcum or stearate of zinc. After an operation for the enlarged veins he should wear a bandage or an elastic stocking in order to avoid recurrences which so frequently take place.

INDOLENT OR CALLOUS ULCER.

This occurs most frequently on the legs of women around middle life. In size it varies from the dimensions of a five-cent piece to the entire circumference of the limb. The surface is usually smooth and glistening and of a dirty yellow color, with perhaps a few badly formed granulations. The edges are hard and sharply cut and elevated considerably above the surface, whilst the surrounding skin may be inflamed over the margin and either covered with sodden cuticle or congested. The integument of the limb is often deeply pigmented from chronic congestion, the pigmentation starting in separate papillæ as maculæ which gradually coalesce. The discharge is purulent or serous and may be so abundant and irritating as to cause eczema of the surrounding parts. The base is adherent to the underlying tissues, and this constitutes one of the main difficulties in healing, as contraction is thus prevented. If the ulcer is situated above a bone, such as the tibia, chronic periostitis results; a subperiostal node is formed corresponding exactly to the size and situation of the ulcerated area and forming a mushroom shaped projection, and necrosis or diffuse periostitis of the whole bone may re-

sult. Such ulcers are sometimes very painful from pressure on cutaneous nerves, or from a localized cellulitis associated perhaps with inflammation of veins and lymphatics. Thrombosis not infrequently occurs in both sets of vessels, leading to chronic edema of the feet.

Etiology. (1) General causes: (a) Various devitalizing fevers and diseases, such as typhoid, scorbutus, diphtheria, chronic nephritis, etc. (b) Mineral poisoning, such as produced by phosphorus. (c) Anemia and debilitating conditions brought on by starvation, improper food, poor hygiene, overwork, lack of sleep, etc.

(2) Local Causes: (a) Old scar tissue, the contraction of which has cut off the circulation, continuous pressure, from splints, lying in bed, etc. (b) Local destruction of the tissues such as is produced by extremes of heat and cold, and sometimes by the x-ray, and by the poisons of reptiles or insects. (c) Local irritation or injury of tissues from violence, pressure or rubbing of clothing, or the presence of a foreign body such as dead bone, a splinter, sloughing tendons, etc. (d) Various diseases of the skin, for example, pemphigus.

These causes, in addition to those previously mentioned under the heading of general considerations,

can be designated as the etiological factors in the causation of chronic indolent leg ulcers.

Symptoms. The most common location in which these ulcers are found is on the inner side of the lower third of the leg. They show great variety in size, shape and appearance of base, edges and surrounding area, and in accordance with these differences many different names are applied to them. The size varies from a small ulcer less than one centimeter in diameter, sometimes found with varicose veins, to the large ulcerations which surround the leg and are called annular ulcers. They may be round, very irregular, or funnel-shaped, as in perforating ulcer of the foot. The base may be much or slightly depressed, or the granulations may be at a higher level than the surrounding edges. When the granulations are large, irregular, and bleed easily, they are spoken of as exuberant or fungating; when pale, soft, and flabby, as weak or edematous; when small and slowly growing, as indolent. Sometimes the base is covered with a grayish or yellowish-white necroctic layer formed of fibrin and necrotic cellular elements. When this is removed no granulations appear, but instead a smooth shining base resembling mucous membrane. This form is known as the croupous ulcer. In some

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cases the base of the ulcer is formed of the body tissues (muscle or connective tissue), and the lesion may look like a fresh injury. These are called raw ulcers. The base of a chronic ulcer may be pigmented. The edges also vary greatly. They may be irregular or sharply cut, moderately thickened, or very much so, due to chronic congestion and edema, with enlargement of the papillæ and proliferation of the epithelial cells. When this is a prominent feature the name callous ulcer is applied. The edges may be adherent to the deeper structures and thus prevent contraction and healing; they may be rounded, elevated, undermined, or overhanging. Usually they are of a uniform height, rarely worm-eaten. When a chronic ulcer shows no tendency to heal it is never shelving, and there is an absence of the bluish-white border, mentioned in connection with a healing sore. The discharge from a chronic ulcer is usually slight in amount, serous in character, and contains very few pus cells. The surrounding area may be swollen, red, congested, edematous, eczematous, pigmented, or the ulcer may be surrounded by smaller sores, by vesicles, or by masses of varicose veins. As a rule there is an absence of severe pain accompanying chronic leg ulcers, unless there is an ex-

posure or involvement of some nerve filaments; but frequently, after the patient has been on his feet for a long time, there is a dull aching sensation in the part, due to chronic congestion, which causes tension in and about the ulcer.

A peculiarly painful form of chronic ulcer is found over the inner malleolus, most frequently in women of middle age, although it also occurs in men. It is often associated with varicose veins, and in women with menstrual disorders, and is known as a **congested, irritable, or erethistic ulcer.** It begins as a small area of congestion over the internal malleolus, which gradually increases in size and becomes darker and more dusky in the center, due to a deposit of blood pigment caused by the chronic congestion. The skin next becomes hard, dry, scaly, and pigmented, while the subcutaneous tissues lose their elasticity, becoming inflexible, hard, and adherent to the deeper structures. Then, as a result of slight traumatism or even without injury, the center of the area breaks down and an ulcer develops. It may be circular or irregular in shape; it may be quite deep or superficial. The edges are sharply cut, and both base and edges are tightly bound down to the deeper tissues. The intense pain characteristic of these ulcers is supposed to be due

to pressure upon the terminal nerve filaments in the dense sclerotic tissue. This form of ulcer is often very difficult to cure, and shows a tendency to return after healing.

Differential Diagnosis. The diagnosis of a chronic indolent or callous ulcer can be easily made by the character of the granulations and by the location of the ulcer itself. The history points usually to an injury or infection, and the situation of the sore is at the site of the previous injury or infection. The base is shallow, inflamed and often of a grayish-yellow color, with no thickening or elevation of its edges. The surrounding area is usually round and inflamed. A varicose ulcer is differentiated by the history of varicose veins or phlebitis, by the situation not being at the lower third of the leg, and by the undermined thickened and irregular shaped edges. A syphilitic ulcer—by the history of lues; by its situation being usually at the upper third of the leg; by a dirty sloughing and deep base; by punched out, thin undermined and red edges; and by old scars of a dusky red color. A tuberculous ulcer—by the history of previous glandular bone or lung disease; soft, pale, edematous granulations; thin undermined edges; involvement of glands and other signs of tuberculous sinuses,

bone disease, etc. An epitheliomatous ulcer—by the appearance of hard, wart-like granulations which bleed very easily; very hard, elevated, nodular, everted edges; by cachexia or metastases.

The prognosis is usually good, but these ulcers may take a long time to heal.

Treatment. This naturally depends upon the time the ulcer is seen and the conditions present. If there is considerable inflammation accompanied by marked cellulitis and pain, the milder of the wet dressings, such as boric acid or Thiersch solution, are indicated. Rest of course is the most important factor. The patient must be prohibited from walking and, if necessary, the movements of the neighboring joints must be prevented by the application of suitable splints. If these be employed they should be so arranged that the limb will be in the position most serviceable to the patient if there be any subsequent stiffness either of joints or muscles. For example, in the case of the lower third of the leg on which ulcers are most frequently met with, it is well to apply a splint which reaches above the knee and fixes the foot at right angles to the leg. After the acute inflammatory symptoms have subsided the red wash is indicated for the stimulation of the granulations. Measures should also be taken

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to get rid of the exudation, which presses on and interferes with the circulation in the part. The elevated position and rest in bed are no doubt sufficient to do this of themselves; but if time be an object, various means may be employed to accelerate the absorption of the exudation. Of these, one of the best is massage. When massage is resorted to with a view of getting rid of the thickening around an ulcer, it should be applied first to the parts above the ulcer; as the skin gets softer in that region, the area subjected to the massage may be increased downwards. If the massage were applied first to the part below the ulcer, the absorption would not be satisfactory owing to the presence of the exudation above.

STRAPPING.

Another way in which the exudation may be got rid of is by pressure, and this is especially useful when patients will not lie down. Pressure may be applied in two ways: either by strapping or by elastic bandages. The older plan was to use strapping, but this is not so good as elastic pressure. If strapping be used, strips of adhesive plaster are applied fairly tightly around the ulcer and the parts in its vicinity. These strips should be rather more than

an inch broad and rather longer than the circumference of the limb. They are applied from below upwards, the center of each strip being fixed at a point opposite the center of the ulcer, so that as the two ends are brought together over the limb they pull the edges of the ulcer together. If the strips were applied with their centers over the ulcer, the reverse would be the case; when they were pulled tight the edges of the ulcer would be separated. The strips should overlap each other for about two-thirds of their breadth, so that only about a third of each is exposed. In this way the whole region of the ulcer, as well as the thickened tissues above and below, are firmly supported and pressed upon by a series of strips of adhesive plaster applied from below upwards. Before beginning the strapping, the whole limb should be shaved, as otherwise great annoyance is caused to the patient when it is peeled off.

One great objection to strapping is that the discharge from the ulcer is confined beneath it and thus undergoes decomposition, and consequently fresh ulceration occurs. The ulcer, therefore, should be disinfected before the strips are applied, and boric lint should be placed over its surface so as to absorb and prevent the decomposition of fluids.

Unless this be done, it will be necessary to cut away the lower parts of the strapping so as to allow the discharge to escape, a procedure which necessarily weakens it. The strapping should be renewed every second day unless there is much discharge, when it must be changed daily.

Strapping has now been largely abandoned in favor of the elastic bandage, that known as Martin's being the most suitable form. Martin's bandage is a thin sheet of pure rubber, cut into strips about three inches wide and of varying lengths; this is wound around the limb, commencing at the ball of the toes and extending up as far as the knee. The best form is that containing a number of perforations to permit of evaporation; otherwise the perspiration accumulates beneath the bandages and may set up a dermatitis.

The above methods of applying pressure are only continued in the case of patients who can afford the time to rest until the exudation has become absorbed. If continued longer, they interfere with the nutrition of the limb.

BLISTERS.

Another plan of getting rid of the exudation accompanying a callous ulcer is blistering by means

of mustard or cantharides plaster. When a blister is applied to the skin, more blood is sent to the part and the lymph flow is increased; if it is applied around a callous ulcer (the limb meanwhile being kept at rest in the elevated position), it is remarkable how quickly the callous condition disappears and the edges become soft and in a condition favorable for healing.

The essential point in employing a blister in the treatment of an ulcer is that it should not be applied directly over the raw surface, otherwise the cantharides is apt to be absorbed and may lead to serious irritation of the kidneys. This must be borne in mind in cases of callous ulcer especially, for many of the patients suffering from this affection are the subjects of Bright's disease. Hence, the blister should be raised around the margin of the ulcer only, while its surface should not be allowed to come into contact with the cantharides. Usually one blister will suffice, and it will be found that by the time the blistered surface has healed the callous condition of the ulcer has disappeared and its edges are in a satisfactory condition.

The part to which a blister is to be applied should be thoroughly cleansed, and if necessary, shaved. In an adult the plaster should be left on for about ten hours; the length of time required for the pro-

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duction of a satisfactory effect varies, however, with the thickness of the skin. Where the skin is thick it may even require twenty-four hours. When the mustard plaster is removed a good sized blister is generally found beneath it; sometimes, however, the skin is merely reddened or a few small vesicles only are present. In case a cantharides plaster is used it should not be left on too long for fear of causing sloughing of the skin, and the danger that the patient runs of absorbing the drug must be borne in mind; should this happen there is considerable risk of nephritis. Blisters should not be applied therefore over large areas covered by thin skin, and should not be used at all when there is any renal disease. When the ulcer is of moderate size with little discharge, either of the two scarlet red ointments previously mentioned should be employed. In cases where there is very little discharge dusting powders, such as dermatol, stearate of zinc, or boric acid, are indicated. A firm compression bandage must always be applied from the base of the toes and carried up to the knee as described elsewhere. Constitutional treatment in the form of iron, arsenic, strychnin, and other general tonics, as well as regulation of the diet and proper hygienic surroundings, are necessary for the cure of chronic indolent or callous ulcers.

EPITHELIOMATOUS ULCER OF THE LEG.

In none of the more common ulcerative skin affections would the conditions for the development of cancer seem to be more favorable than in chronic dermatitis with ulceration, the neglected and despised varicose ulcers of the leg. The extreme chronicity of the inflammatory process, often lasting for many years; the age of the patient, which is usually advanced; the almost inconceivable neglect of the lesion in many cases, so that the persistent presence of foul and decomposing secretion and of the products of tissue necrosis is common; the frequent absence of even an attempt of rational treatment; the usual presence of vascular and lymphatic conditions in the skin of the affected part which entirely prevents any spontaneous attempt at cure; the fact that most of these patients are compelled to be on their feet all day and thus to keep up and increase the unfavorable vascular conditions, and finally the circumstance that in many of them the added history of alcoholism, of renal or cardiac disabilities or of other chronic affections is also present — all these would lead to the presumption that in this ulcerative lesion, above all others, carcinomatous degeneration will be most common.

The literature on this subject shows only ten recorded cases. While so few instances of cancer secondary to varicose ulceration have been reported, and while many of the text-books do not mention the possibility of its occurring, some of the latter refer to it in quite a casual way, as if it were an occurrence so common and of such little consequence as to barely require notice, impressing one with the idea that a venerable surgical tradition rather than actual experience on the writer's part is its source. Bryant and Buck say that chronic ulcer in elderly people and lupus patches may at times undergo epitheliomatus transformation, and they describe very briefly the superficial signs of this change, yet make no mention of it when discussing varicose ulcer itself. Tillman merely says in very small print that epitheliomata sometimes develop in old ulcers of the leg of large size among persons in advanced years. Occasional reference is made, as in Da Costa's work, to Marjolin's ulcer, which is apparently an old name for the lesion under consideration. Some fifty years ago Marjolin described a class of cases where chronic ulcers had undergone malignancy, and hence the name Marjolin's ulcer. Noble in his very exhaustive monograph on the varicose condition, devotes three pages to cancer,

mostly occupied, however, with an account of his three cases. Regarding the frequency of its occurrence he says that the very scanty data give us no information at all. In a number of Viennese clinics where numerous leg ulcers are constantly being treated, not a single case of this kind has been seen during the past year.

Epitheliomatous ulcer of the leg is infrequent under forty years of age. It is usually seen where varicose ulcers as well as the scars they produce are found. The base of the characteristic ulcer is hard, nodular and irregular, made up of firm, warty granulations, and often covered with sloughs. It bleeds easily and has a foul discharge. The edges are hard and everted. The borders and base present a peculiar and striking thickness and hardness, as though the ulcer were imbedded in cartilage, while the granualtions feel firm and appear red and warty. The amount of pain, the involvement of neighboring lymphatic glands, and the rate of growth vary. Epitheliomata which have developed from congenital warts, moles, or nevi are apt to be very malignant. When epitheliomatous degeneration occurs in a chronic ulcer, it first begins to get hard about the edges, which become everted and gradually bound down to the deeper tissues. The granulations about

the margins become large, red, nodular, hard, and bleed very readily. This condition spreads over the entire ulcer, which assumes a sloughing and foul character. The diagnosis is confirmed by the microscopical examination of a section cut from the edge of the ulcer.

The diagnosis can easily be made by the above symptoms.

Treatment. Malignant ulcer can be cured only by the destruction or removal of the new growth. For its treatment caustics with or without curetting, excision or radiotherapy, may be employed. The best caustics are arsenic, chloride of zinc, caustic potash, and formalin. The objections to this method are the extreme pain, the lack of certainty as to the removal of all of the neoplasm, the fact that the lymphatics and glands are not dealt with, as well as the fact that unless the treatment is thorough the growth is stimulated rather than retarded. The scar is also apt to be unsightly. Without doubt excision forms the best method of treatment. The incision should be wide of the ulcer, and all indurated tissues and any lymphatics or glands that are involved must be removed. In some cases it may be necessary even to amputate the leg in order to effect a cure. Finsen has reported a number of malignant

ulcers treated by his light methods, some successfully and some not, but since the report of cases successfully treated by means of the x-rays this method has been thoroughly tested and employed in this condition.

Recently radium has been used in these malignant ulcers of the leg with good results. The gamma rays are to be preferred as they are more penetrating and should be applied two or three hours a day for a number of days. At least from 50 to 200 milligrams of radium must be used in order to produce any effect. Two French writers, Wickham and Degrais, have especially recommended this form of treatment. In this connection it has recently come to my attention that Dr. Abbe in his extensive experience with radium has reason to believe from his recent experiments that the Beta rays may have fully as curative properties as the Gamma rays.

VARICOSE ULCER.

Etiology. To chronic ulcers of the leg associated with varicose veins, especially of the smaller venous radicles, the name varicose ulcer has been given. The usual development of this variety of ulcer is as follows: Persons who suffer from varices of the leg usually complain for some time before the external manifestation of the disease of a deep aching pain in the limb, with a sense of weight, fullness and fatigue. In a more advanced state of the disease the ankles swell after a hard day's work, and the feet are constantly cold; an embarrassed state of the circulation is denoted by these symptoms and the deep-seated veins begin to swell. After a time, which varies with the idiosyncrasy and occupation of the patient, small, soft, blue tumors are seen at different points of the leg, most of them disappearing on pressure, but returning when it is removed or when the patient stands up. Each little tumor is caused by a vein dilated at the point at which it is joined by an intramuscular branch. Around many of these tumors a number of minor vessels of a dark purple color are clustered, these being the small superficial veins which enter the dilating vein and in which the

passage of the blood is retarded. An increasing area of veins gradually becomes involved and a number of irregular, knotty, consolidated tumors are developed, grouping themselves around the point at which the dilatation first began. The external and internal saphenous veins are those principally affected, but long tracts of tortuous veins may extend up the leg and thigh. Dangerous and even fatal hemorrhage may ensue from the bursting of a varix through the skin. The vessels may become filled with clots and permanently obstructed, and ulceration with thrombosis or phlebitis may be the sequel. The capillaries become engorged with blood, and hence the assimulation changes are retarded and sometimes altogether checked. Gradually the entire circulation is arrested. The vitality of the superficial structures becomes permanently impaired; consequently they are unable to resist the effects of slight injuries and repair fails to take place after a portion has been destroyed and an open sore or ulcer is established.

Symptoms. The features assumed by varicose ulcers are of less importance than a distinct recognition of their cause, and are determined by constitutional and local factors. The type usually presented is that known as the irritable varicose ulcer,

It is generally found in persons of good health and strength, and is situated in the superficial layers of the skin. It is characterized by hyperemia and pain and may extend deeply into the connective tissue of the cutis, at times involving the fascia of the limb. The varicose ulcer is usually single, oval, round, or irregular in outline, and is most often seen on the lower third of the leg near the inner malleolus. The edges are thick, everted and swollen. The swelling is largely due to edema and is found to pit on pressure. The floor is generally covered with rather large granulations which bleed freely when touched.

In a varicose ulcer the destruction of tissue often begins at the margin of a congested area and advances toward the center. The size varies from the small sores less than one-half inch in diameter, formed by the breaking down of an area of periphlebitis around a small vein, to those several inches in diameter. Several ulcers may be present on one limb. The granulations are weak and flabby. Two or more sores may become connected by the undermining of the skin between them, this subsequently melting away so that one irregular ulcer remains. The discharge is thin, serous, mixed with debris, and may be blood-stained. The skin surrounding a

varicose ulcer is often of a brownish blue color, due to a deposit of pigment. Frequently a leg which is the seat of varicose veins or which is edematous from other causes, is attacked by acute eczema.

The recognition of varicose ulcers is usually easy; but the mere presence of enlarged veins, it should be noted, is not pathognomonic, because they may often exist along with ulcers of other origin — tuberculous, syphilitic, neurotic, etc.

The surface of varicose ulcers usually present imperfect and unhealthy granulations, secreting a more or less thin and offensive pus, and they are sometimes covered with membranous exudation. The edges and base are thickened and callous, and enlarged veins, capillary or otherwise, are present near the circumference and often amount to genuine blood-tissue which tunnel the infiltrated tissues. In examining such an ulcer one gets the impression of a great pigmented scar, the center of which has broken down. Lymphangitis and venous thrombosis are not of infrequent occurrence in connection with varicose ulcers, while embolism and even pyemia are sometimes met with.

Among the most frequent complications is cellulitis, and this may sometimes be so severe as to

	TRAUMATIC.	VARICOSE.	SYPHILITIC.
HISTORY	Injury.	Varicose veins or phlebitis.	Syphilis.
SITUATION	Where the injury occurred.	Usually in lower third of leg anteriorly or laterally.	Usually upper third of leg. Often posterior aspect.
BASE	Shallow, inflamed; often grayish yellow.	Bluish, pigmented granulations; sluggish. Usually superficial.	Dirty, sloughing; often greenish. Deep.
EDGES	Not elevated or thickened.	Undermined or thickened. Shape irregular.	Punched out or thin and undermined; deep dusky red. Shape round or serpiginous.
SURROUNDING AREA	Red and inflamed.	Pigmented. Varicose veins, often edema and eczema.	Dusky red. Scars of old syphilitic ulcers.
HEALING	Rapid under antiseptic treatment.	Support of veins necessary.	Mercury and potassium iodide necessary.

CHART FOR DIAGNOSIS OF ULCERS.

necessitate operation. Erysipelas may also occur in cases of varicose ulcer, and hemorrhage is a common and serious complication and has been fatal at times.

As extreme and unusual complications in bad cases should be mentioned necrosis of bone, the formation of osteophytes, involvement and ankylosis of the ankle-joint, together with atrophy and contracture of muscles and adhesions of tendons, perhaps giving rise to various deformities of the feet, such as flat-foot or even club-foot.

Differential Diagnosis. For the differential diagnosis of varicose ulcer from the other common ulcers of the leg the following table points out the chief differences:

Treatment. The treatment of varicose ulcers must be based on: (1) Antiseptic cleanliness; and (2) improvement of nutrition by improvement of the circulation of the blood and lymph. Then again the treatment will vary according to the time when the varicose ulcer is first seen by the physician. In aggravated ulcers, especially those accompanied by old crusts, foul smelling discharges and various inflammatory conditions, the leg should be washed once or twice daily with soap and water and a piece of gauze, and shaved when necessary. Warm ap-

plications should be employed, such as solutions of boric acid, aluminum acetate, etc., the stronger antiseptics being uncalled for and often giving rise to eczema. Under such treatment in most cases the swelling and irritation will subside and the ulcer become clean and more healthy in appearance, especially if a patient be confined to bed with elevation of the limb. The milder of the solutions referred to in the chapter on "Treatment of Ulcers" should be used when the limb is in a highly inflammatory state, and after the acute symptoms have subsided the stronger solutions should be employed according to the indications. The reason why wet dressings are to be preferred at this time has also been mentioned. Where there is very little secretion, any of the dusting powders given under the head of local treatment may be used for the stimulation of the granulations. The scarlet red ointment as well as other remedies previously discussed should be resorted to according to their indications, and strapping of the ulcer may be required.

Whenever possible the patient should be kept in a recumbent position with the leg slightly elevated, not only until the ulcer is healed, but until the scar has become sufficiently resistant to insure its further integrity. This always seems to the patient

a useless waste of time, but in reality time is thus saved. It is by far the most important point in the treatment of ulcers of the leg in which poor circulation is a factor, but the plan must be carried out consistently in order to obtain the best results. It does not admit of occasionally walking about the house or sitting in a chair. However, when circumstances do not permit of the recumbent position, the veins can be supported in various more or less effective ways. We may employ bandages of plain rubber, or rubber cloth, or woven and rendered elastic by the character of the mesh, or elastic stockings, or flannel, gauze or muslin bandages. Of all of these I prefer the flannel bandage for reasons heretofore mentioned. The best means of obtaining the support, however, is by the use of Unna's paste. The technic and application of this method of treatment has also been described (chapter on "Local Treatment").

A useful procedure in many ulcers where the blood supply is interfered with by surrounding cicatrical tissue is to loosen up the callous area by incisions, so as to increase the circulation and permit of contraction of the granulating surface. The method of Nussbaum is probably the most effective. In this the ulcer is encircled at a distance of from

one-half to one inch by a cut completely surrounding it and reaching entirely through the thickened skin, or a number of radiating incisions of a like depth may be carried from the center of the ulcer wall out through the callous margin. Others recommend passing a tenotome beneath the ulcer and detaching its indurated base from the structures below. Scraping an indolent ulcer or rubbing off the granulations with gauze will sometimes stimulate it to renew activity, as will also cauterization every few days with stick of nitrate of silver, pure carbolic acid, 10 per cent. chloride of zinc, or the application of the fly blister. The x-ray has been employed in these chronic varicose ulcerated conditions with beneficial results. Biers' arterial form of hyperemia has likewise been used with excellent effect. In some cases skin grafting can be resorted to with satisfactory results, provided the surface is protected from injury for several weeks following the operation by means of bandages, salves, and appropriate dressings. This method of Thiersch I have already dwelt upon.

Operations upon varicose veins are frequently called for in aggravated cases, provided the general condition of the patient permits. Briefly these may consist in multiple ligations; in ligation of the in-

ternal saphenous alone; in extirpation of large or small sections of the varices; in circumcision of the skin of the leg above the ulcer, or of the ulcer itself, tying all the veins and reuniting the cuticle. However, it must not be forgotten that in the presence of an ulcer, infection of an operative wound is likely to occur.

PERFORATING ULCER OF THE FOOT.

Perforating ulcer of the foot occurs in connection with lowered resisting power of the tissues, due usually to some lesion of the nerves or vessels. The ulcer is circular in shape, painless, with callous borders, and eats progressively into the deeper soft tissues and bones, and has little or no tendency to heal.

Etiology. Although formerly looked upon as a specific disease, perforating ulcer is now known to depend upon many local and general conditions, of which it is occasionally a more or less accidental manifestation.

The various theories as to its immediate causation may be divided into (1) mechanical, (2) vascular, (3) nervous, and (4) mixed.

(1) The mechanical theory regards injury as the sole cause, due in most instances to the pressure or rubbing of a shoe. If this explanation were adequate, however, such ulcers would be extremely common, while in reality they are rare.

(2) The vascular theory assumes that arteriosclerosis is always present, and causes ischemic necrosis through arterial and capillary thrombosis.

(3) The nerve theory, which is the one most

commonly accepted, is that perforating ulcer is always of trophic origin and depends upon a chronic peripheral neuritis. In support of this assertion, attention is called to certain interstitial and parenchymatous alterations frequently demonstrable in the nerves of the affected part.

It must not be forgotten, however, that these nerve changes may be due to secondary disturbances in nutrition, depending upon arteriosclerosis, as in senile, diabetic and other forms of gangrene.

(4) According to the mixed theory either vessels or nerves, or both, may be at fault. It admits that traumatism is an important factor, although seldom, if ever, an exclusive cause.

Perforating ulcer is observed in connection with various diseases and conditions, the most prominent of which are locomotor ataxia, fractures of the spine with injuries to the cord, diabetes, syringomyelia, spina bifida, progressive paralysis, injury and division of peripheral nerves. Perforating ulcer from lesions of the central nervous system is comparatively rare, and it is doubtful if it is ever due to embolism or to ligation of arteries.

The three most prominent causes, therefore are (1) Affections of the spinal cord, (2) injuries of the peripheral nerves, (3) diabetes. This variety of ulcer is seen more frequently in males than in females, and is almost exclusively confined to adults, especially between the ages of forty and sixty. Occupations requiring standing or walking are strong predisposing causes, provided a tendency to the disease already exists. A poor fitting shoe and deformities of the foot giving rise to excessive pressure or irritation are of much importance in determining the appearance and location of the ulcer. It rarely appears in children, unless it is associated with spina bifida.

Symptoms. Perforating ulcer has a marked tendency to develop where pressure and irritation are greatest, which is almost always upon the sole of the foot at the junction of the great or little toe with the metatarsus. It may occur, however, upon the heel, the sides of the foot, the plantar surface of any portion of the great toe, or even upon the center of the sole, these unusual situations being most commonly found associated with diabetes.

When talipes or "hammer toe" exists, the ulcer is apt to occur wherever pressure is pro-

nounced, even upon the dorsum of the foot or the ends of the toes. Usually but one foot is affected, although both feet may be involved, in which case the disease is often symmetrical.

Three stages may be recognized in the development of the ulcer: (1) The formation of callosities, (2) superficial ulceration, and (3) deep ulceration.

Very frequently in tabes and in diabetes a purulent blister is the first indication of trouble, but usually a marked epithelial thickening, in the form of a corn or bunion, is the initial symptom. Sooner or later the center of a callosity breaks down into a bluish, unhealthy, indolent, superficial ulcer, secreting a watery pus, small in amount and with an offensive odor. The sore is circular, as though punched out of the callous tissue, the latter at times so thickened and overhanging that the ulcer is almost concealed beneath it. There is little or no tendency to heal, even under the best treatment, and if recovery should take place, a speedy relapse is the rule, even with the patient remaining quiet in bed.

The indolent and often foul ulcer tends to eat deeply into the adjacent tissues, progressively involving bursa, tendons, muscles, joints and

bones. A deep round hole results, which may even perforate the foot.

The most striking symptoms are chronicity, stubborn resistance to treatment, and the absence of pain and tenderness.

The fact that perforating ulcer is so often found in connection with lesions of the nervous system accounts for the abnormalities of sensation, motion and reflexes which frequently accompany it. This explains the various trophic disturbances which are very often observed, such as epithelial growth not only in the vicinity of the ulcer but occasionally over the entire foot and leg; also eczema, erythema and excessive perspiration. The nails are frequently thickened and distorted, and the subcutaneous cellular tissues so changed as even to suggest elephantiasis.

Inflammatory complications, sometimes serious, are not uncommon owing to infection through the ulcer, and an ascending neuritis may even result in myelitis. Gangrene from arteriosclerosis is also frequently seen.

Treatment. In those predisposed to diabetes tabes, etc., prophylaxis deserves consideration. The shoes must fit accurately and without undue pressure; much walking is to be avoided; when

ulceration has begun the recumbent position and cleanliness are of paramount importance. The callous epidermis should be removed so as to render the sore as superficial as possible. Dead bone must be scraped away, or extracted if in the form of a sequestrum, and drainage must be perfected by enlarging the opening. Sinuses should be enlarged and any pockets found should be thoroughly opened.

It must be emphasized, however, that operative interference should be undertaken with care and discretion owing to the tendency of the poorly nourished tissue to necrosis and infection.

Periodic curettments and cauterizations with silver nitrate or pure carbolic acid are often of service, as are also the employment of dry iodoform gauze as a packing, together with the occasional use of various moist dressings.

Both the constant and interrupted currents of electricity have been resorted to with benefit, sometimes locally and sometimes applied to the spinal cord or affected nerves. Measures directed to the improvement of the circulation of the foot, such as massage, stimulating bath, and lotion are occasionally of service.

Bier's arterial hyperemia in the form of baking

of the foot by means of a gas or electric apparatus especially devised for this purpose, as that of Tyrnauer, is of great benefit, more so when there is a neuritis accompanying the ulcer. The baking should be done once a day for ten to twenty minutes, and the temperature should be gradually increased from 100 deg. F. to 300 deg. F., depending upon the patient's ability to tolerate the heat.

The passive, venous or obstructive form of hyperemia is absolutely contraindicated in this class of ulcers.

The initial cause of the trouble must receive attention, because upon its successful management depends the cure much more than upon local measures. Diabetics and syphilitics should receive appropriate treatment.

The bad cases, especially where gangrene or serious infection exists, may require amputation, but unless this can be done in sound tissue with adequate innervation, a perforating ulcer may develop upon the area exposed to the pressure of an artificial limb. Resection of joints is usually of little benefit. The most satisfactory operative results in this class of ulcers have been obtained by stretching the posterior tibial nerve, together

with scraping the ulcer or, better, excising it and immediate suture of the wound. The operation is best done through a curved incision beneath the internal malleolus, the nerve being isolated and vigorously stretched in both directions by means of some blunt instrument inserted beneath it. Sometimes the external or internal plantar nerve alone is treated in this manner.

TYPICAL VARICOSE ULCER.

TYPICAL SYPHILITIC ULCER WITH ENLARGED VARICOSE VEINS.

SYPHILITIC ULCERS.

Syphilitic ulcers may result from pustules or tubercles, or may begin as tertiary sores. They occur frequently where the integument is thin, or where it is kept moist by the natural secretions of the part.

In syphilitic ulceration the destructive process is preceded by a productive one. The superficial syphilitic ulcers, or those of the late secondary or tertiary stage, are preceded by round-celled infiltration, which may break down at once and form a pus focus from which an ulcer develops, or one or more tubercles may form and become necrotic.

It is by the spreading and marginal growth of one of these tubercles or the progressive involvement of others, while healing is going on at one part of the ulcerating area, that the syphilitic ulcer forms.

The deep ulcers of tertiary syphilis develop from gummata. These are variously-sized deposits largely made up of large spheroidal cells, with some polyhedral and occasional giant cells. They are poorly supplied with bloodvessels and undergo coagulation necrosis, but do not tend to suppurate until infected. Sooner or later the overlying skin

becomes involved, either with or without a secondary pyogenic infection, and the gumma then sloughs out, leaving the typical syphilitic ulcer.

A protozoon, the spirochete pallida, is found in small numbers in the lesions. Noguchi has been able to cultivate this, and it is now recognized as the cause of syphilis.

Symptoms. When a syphilitic ulcer develops it usually assumes one of two types, superficial or deep.

The superficial ulcer may appear comparatively early in the disease. It usually varies in size from a quarter to a half dollar piece, has a circular outline, sharply cut, indurated edges, and a dirty, yellowish base. Several borders may unite to form an ulcerated area, with a scarlet margin.

The deep ulcers result from the breaking down of gummata. They are, at the beginning, surrounded by a reddened area of inflammation, the small ones being crater-like, with "punched out" edges, the larger ones having overhanging thin, soft, inflammed edges. The base is indurated and of a dusty, red color, dirty or sloughing in appearance, the slough being often of a greenish color. The discharge is thin, frequently bloody,

and contains debris from the broken down gumma. The surrounding skin is indurated.

Under treatment, and after they have existed for some time, they lose their characteristic appearance and take on the form of simple chronic ulcers.

The scar remaining is characteristic. It is thin, of a dead-white color, pigmented here and there, and when pinched it wrinkles like tissue paper.

This form of syphilitic ulcer is found most frequently on the upper third of the leg.

When these ulcers are accompanied by enlarged varicose veins, it is extremely difficult at times to make a differential diagnosis between a luetic ulcer and one of a varicose type.

Diagnosis. The chief differential points are as follows:

Location: *Varicose Ulcers* — The lower third of the leg.

Syphilitic Ulcers — Middle and upper third of leg.

Appearance: *Varicose* — Irregular, not undermined; granulations reddish, exuberant.

Syphilitic — Typical "punched out," sharp undermined edges; greyish discharge, thin and watery.

Varicose — Usually single.

Syphilitic — Multiple, having a tendency to coalesce and form one large ulcer.

A very characteristic point is that a syphilitic ulcer once healed always remains so.

At times it is extremely difficult, even in view of the differential points already mentioned, to make a distinct diagnosis between a varicose and a syphilitic ulcer; then the Wassermann reaction should be resorted to, but too much stress should not be placed upon its findings. It may happen that a patient having a suspected luetic ulcer is given mercurial treatment, with the result that the reaction is negative, but this should not exclude the possibility of syphilis existing. A positive Wassermann in a case of chronic ulcer with enlarged veins which refuses to heal warrants the diagnosis of a syphilitic lesion. In a great many cases the Noguchi luetin skin reaction is of great aid in establishing a diagnosis.

Treatment. The treatment is both local and general. As regards local treatment, if the ulcer secretes very freely, either the blackwash or a solution of bichloride, varying from 1 in 5,000 to 1 in

10,000 should be employed. Where there is very little discharge calomel powder is indicated.

Of course it is understood that in all these cases, especially those complicated with enlarged veins, a firm compression bandage should be applied, beginning at the base of the toes and carrying it up to the knee.

The general treatment consists of the intravenous injection of either 10 gr. of salvarsan or neosalvarsan, and the administration of iodides and mercury internally.

TUBERCULOUS ULCER OF THE LEG.

A tuberculous ulcer usually results from the bursting through the skin of a tuberculous abscess. The base is soft, pale and covered with feeble granulations and gray, shreddy sloughs. The edges are of a dull blue or purple color and gradually thin out toward their free margins, and in addition are characteristically undermined, so that a probe can be passed for some distance between the floor of the ulcer and the thinned out borders. At times the edges are solid and puckered, being scar-like in character. Thin, devitalized tags of skin often stretch from side to side of the ulcer. The outline is irregular; small perforations often occur through the skin and a thin watery discharge containing shreds of tuberculous debris escapes. The ulcer is usually superficial and very little pain is present. At times it is crusted over, the crust being thin and of a brown or black color. Again it may be progressing at one point and healing at another; it is slow in advancing but often proves very destructive. The scars left by its healing are firm and corrugated, but are apt to break down.

Treatment. The local treatment of the tuberculous ulcer calls for special mention. If the ulcer

is of limited extent the most satisfactory method is complete removal by means of the knife, scissors, or sharp spoon of the ulcerated surface and all of the infected area around it, so as to leave a healthy surface from which granulations may spring. If the raw surface left is likely to result in cicatricial contraction skin grafting should be employed. The general treatment has already been referred to.

BAZIN'S DISEASE.

This term is applied to an infection of the skin and subcutaneous tissue which bears certain resemblances to tuberculosis. It is met with almost exclusively between the knee and the ankle and usually affects both legs. It is commonest in young women, of delicate constitution, in whose family history there is evidence of a tuberculous taint. The patient often presents other lesions of a tuberculous character, notably enlarged cervical glands. The tubercle bacillus has rarely been found, but characteristic epitheloid and giant cells are present. The condition begins by the formation, in the skin and subcutaneous tissue, of dusty or livid indurated nodules which soften and ulcerate, forming small open sores with ragged and undermined edges, but unlike those resulting from the breaking down of superficial syphilitic gummata. Fresh crops of nodules appear in the neighborhood of the ulcers, and in turn break down. While in the nodular stage the affection is very painful, with the formation of the ulcers the pain subsides. The disease runs a very chronic course, and may slowly extend over a wide area in spite of all the usual

methods of treatment. After lasting months or even years, however, it may eventually undergo spontaneous cure.

The most satisfactory treatment is to excise the affected tissues and fill the gap by some method of skin grafts, such as Thiersch's.

BLASTOMYCOTIC ULCER.

This is not a common condition in the lower extremity. It is found near the lower third of the leg, and begins as a papule or papulo-pustule, soon becoming covered with a crust which on removal discloses a papillomatous area. The typical ulcer is elevated, verrucous or fungating, with a soft base which is infiltrated with a sero-purulent secretion. The border is dark red or purple and slopes more or less abruptly through the normal skin, from which it is sharply defined. The quickest and most positive method of differentiation is by means of microscopic and bacteriologic examination of the tissues. The organisms are fungi, known as blastomycetes, saccharomycetes or yeasts, characterized especially by their mode of multiplication or cell division called budding.

Treatment. In all cases thorough cleansing of the ulcer with antiseptic lotions, as previously described, is of great benefit. Complete extirpation of the ulcerative lesions has been successful, but curetting does not always prevent their recurrence. Potassium or sodium iodide in large doses (100 to 400 grains per day) with radiotherapy seems to be the most efficacious form of treatment. Copper sulphate in a 1 per cent. solution as a wash for external use and also in 1-4 grain doses internally has in some cases given good results.

ACTINOMYCOTIC ULCERS.

In the leg these ulcers are extremely uncommon, and differ very little from blastomycotic ulcers except for their bacteriology. The prognosis in this class of cases is usually very bad.

MYCETOMA OR MADURA FOOT.

This is primarily a disease of the warm climates and is very rarely seen in our country. For this reason it has not been deemed necessary to describe it.

PHLEBITIS.

Phlebitis is a term first applied by Breschet (1818) to designate inflammation of the veins. John Hunter was one of the first observers to associate the evil effects (septic phlebitis), which sometimes followed the old practice of venesection, to inflammation of the veins. Later came the notable contribution of Cruveilhier in 1834, who, striving to account for the constant association of thrombosis with phlebitis, concluded that the thrombus formation was always dependent upon a previous inflammation or injury of the vessels. In this view he was contradicted by Virchow, who maintained that phlebitis was always secondary to clotting or thrombus formation in the veins. For years Virchow's views prevailed, but at present Cruveilhier's dictum that thrombosis is, as a rule, secondary to disease of the endothelium in phlebitis, is universally accepted (Bougle). While it is evident that there are exceptions to this general rule and that thrombus formation may precede the development of the phlebitic process, or the degenerative changes in the endothelium with which thrombosis is always associated, it may be said that this statement applies to all forms of septic phle-

bitis in which the inflammatory or degenerative process is started by the direct deposition of micro-organisms in the intima by the blood-streams, or by contact with irritant poisons contained in the blood itself. In this respect septic phlebitis differs markedly from the septic arteritis, the inflammation beginning in the latter more often as an embolic thrombo-arteritis, caused by the detachment of a septic fragment, set free from the heart chambers or their valves, the embolus becoming lodged in some peripheral artery where it starts a secondary and septic arteritis. Again, it must also be recognized that in consequence of the sluggish circulation in the veins, in the lower extremities particularly, thrombotic clotting may occur as a primary factor, especially in the constitutional diseases in which hemolytic processes are going on with great liberation of agglutinins from the disintegrating corpuscles. It is also possible for colonies of micro-organisms to become localized in areas of sluggish circulation and cause coagulation by the ferment-like action of their toxins before an actual or appreciable alteration has been started in the endothelium. This must be a very exceptional occurrence, however, and it may be safely asserted that thrombus formation rarely occurs in the venous

system without a primary injury or disease of the endothelium as a determining factor.

Phlebitis, with its associate thrombosis, is a far more frequent pathologic process than the corresponding lesion of the arteries. This is readily accounted for by (1) the greater thinness and permeability of the venous coats, which allow the microorganisms to pentrate them more readily; (2) by the comparative sluggishness of the venous circulation in the peripheral parts; (3) by the superficial and more exposed distribution of the veins in the subcutaneous areas, which subject them to more frequent obstructions from injuries and extraneous causes; (4) by the greater coagulability of the venous blood.

Classification. In a general way phlebitis may subdivided into: (1) Aseptic; (2) toxic; (3) septic.

Aseptic Phlebitis. This is characterized by the limitation of the local tissue changes involved in the process of repair and regeneration, and is, therfore, not inflammatory, surgically speaking. Hence the term phlebitis is scarcely justifiable in such cases.

Toxic Phlebitis. The word aseptic has also been used to distinguish certain non-purulent forms of

phlebitis of obscure etiology, in which there are unmistakable degeneration changes in the endothelium, if not positive inflammatory signs, and of which venous thrombosis is an unfailing accompaniment. In these cases the process resolves itself without suppuration and without any clinical or bacteriologic evidence of direct microbic infection. In this group the presumable cause of phlebitis is a toxemia, due to the presence in the blood of autogenic and metabolic poisons or of heterogenic toxins; these acting as irritants (amboceptors, Ehrlich) cause destructive changes in the protoplasm of the cells which favor thrombus formation. These degenerative structural changes may, for convenience, be classified as inflammatory, though they are never associated with the violent leukocytic reactions which characterize the true inflammations (Grawitz). Gouty, rheumatic, chloric, cachectic, and many of the aseptic postoperative thromboses are examples of this group.

Septic Pyogenic or Purulent Phlebitis is the second and most formidable division of this septic group. It is essentially dependent for its causation upon the localization and colonization of pyogenic microorganisms (staphylococci and streptococci) in the venous walls, thus accounting for the great

tendency to migration and metastasis displayed by infections of this type. A notable example of this group are the ulcers of the lower extremities.

In all these forms of phlebitis, excluding the strictly aseptic type, progressive purulent thrombosis occurs in the veins; hence the term thrombophlebitis, which is used synonymously with phlebitis, because of the universal association of blood clotting with the infectious lesions of these vessels.

The prefixes prei-, meso-, and endo-phlebitis are applied here, as in the arterial pathology, to distinguish not the limitations of the inflammation or the infection to either one of the three coats of the artery, but to accentuate or indicate the starting-point of the process and the seat of the most marked lesions. All forms of phlebitis invariably involve all the tunics and reach the endothelium or the intima, either as an initial or a terminal process.

In accordance with the duration and extent of the inflammatory process, phlebitis may be acute, subacute, or chronic, partial, circumscribed, or diffuse.

John Hunter classified phlebitis into three clinical types: (1) *The adhesive or plastic form;* (2)

the suppurative or purulent; and (3) *the ulcerative.* This classification has remained classic almost up to the present time. Hunter could not conceive of any so-called aseptic form; his plastic form is included in the toxic, non-pyogenic septic types; his suppurative form is the pyogenic septic, and the ulcerative form is merely a derivation of the diffuse type of the present circumscribed purulent or pyogenic phlebitis.

Etiology and Pathogenesis. The etiology of all forms of phlebitis, with the exceptions previously mentioned, is inseparably linked with microbic infection and the autogenic toxic process involved in certain forms of perverted metabolism (gout, rheumatism). The *toxic or septic form,* with which we are especially concerned, is associated with the presence of the pyogenic organisms, staphylococci, streptococci, bacillus tuberculosis, the microorganisms of the exanthemata, of syphilis, and other diseases

Whether the phlebitis begins as an endo-phlebitis or a peri-plebitis, the immediate primary effect of the contact of the microorganisms or their toxins with the endothelium of the vessels is to produce certain definite changes in the protoplasm of the cells, which lead to the coagulation of the blood

and the formation of thrombi, the most serious and dreaded complication or sequel of thrombosis being embolism.

The *toxic, attenuated, non-pyogenic forms* and *non-traumatic* varieties of phlebitis occur most frequently and typically in the lower extremities, where they have been recognized and described from time immemorial under the name of phlegmasia alba dolens — a term which is applied at the present time not only to the post-puerperal type of thrombophlebitis, but to the forms observed as sequelæ or intercurrent complications of abdominal operations and the infectious diseases. Usually the left leg is the preferred seat of the affection.

SEPTIC PYOGENIC PHLEBITIS.

This differs essentially from the non-pyogenic and toxic varieties in that there is an intensification of all the local and constitutional signs and symptoms, and a greater acuteness and rapidity of the process. When the phlebitis originates in an inflamed ulcer, its advent is recognized by a train of signs and symptoms which usually point to a joint involvement of lymphatics and veins (acute phlebolymphangitis). Pain is at once felt in the limb along the track of the inflamed veins. The overlying skin becomes hot, red, and tender, and the lymphatic nodes in the groin swell; there is marked edema, but the inflamed venous cords can be readily felt. The constitutional disturbance is marked — rigors and high temperature (103° to 105° F.) of a remittent or intermittent type, followed by profuse sweats. The general condition, facies of anxiety, dry and parched tongue, delirium and general distress, at once direct attention to the infectious nature of the trouble.

The contrast between this angry inflammatory condition, with its red and inflamed skin and high fever, and the white, sometimes cold, marbled skin, reaction, is most striking. The leucocyte count

will show a marked increase in the polynuclears and blood-plates, as is the case in all the pyogenic processes, contrasting in this way also with the phlegmasia types, in which there is a comparatively low leucocytic reaction.

The local signs in a few days tell of the progressive tendency to suppuration by the deep infiltration and edema over the inflamed veins. Areas of softening soon develop, fluctuation is felt in one or several places along the line of the vein, and periphlebitic abscesses will discharge spontaneously or can be evacuated by incision. The pus is reddish, grumous, and thick.

In some cases, in which the infection is less virulent or the resistance of the tissues greater, the endophlebitic foci of suppuration may be multiple, but they will appear as small circumscribed collections arranged in longitudinal series, suggesting the appearance of a chaplet strung on a thread. In these cases, if the vein is excised, the entire string of abscesses may be enucleated en masse with the vessel. These are the more favorable cases, in which the process is limited and the prognosis more favorable. They contrast agreeably with the diffuse pyogenic variety, in which the thrombus quickly breaks down and softens into a purulent mass which

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is soon disintegrated and swept into the circulation. The clinical picture is then that of an acute, rapidly progressive septicemia. The patient may die in a few days or even hours, totally overwhelmed by the intensity and diffusion of the toxins, or if he survive long enough, will succumb ultimately to exhaustion, marasmus, and a chronic pyrexia of a hectic type, consequent upon the succession of metastatic abscesses which develop from multiple pyogenic infarcts in the lungs, liver, kidneys, brain, heart, the serous cavities, and the joints.

Diagnosis. The diagnosis of phlebitis is, as a rule, simple and unmistakable. Lymphangitis is frequently associated with the process, especially in the acute pyogenic variety. The association with lymphangitis always exaggerates the edema, the redness of the skin, and the enlargement of the glands. In some of the varieties of toxic phlebitis, the local signs, often marked externally by a normal appearance, may be confused with those of muscular rheumatism and even with periostitis. Sometimes the first suspicion of the existence of phlebitis is only aroused by the occurrence of symptoms of embolism in the pulmonary tract or in the internal organs. As a rule, the diagnosis of phlebitis, when we bear in mind the clinical history previously given, is easily established.

Prognosis. Phlebitis, no matter of what kind, is always a source of grave concern, more especially in the pyogenic forms. Its dangers must never be overlooked, even in the mildest cases or in the most aseptic surgical procedures on the veins. Even after apparent complete recovery, death may occur suddenly from displacement of a clot.

Treatment. The treatment of phlebitis may be classified into preventive and curative, the latter being subdivided into (a) general, symptomatic or constitutional, and (b) local or surgical.

The *preventive treatment* is summed up in the word "asepsis." The influence of asepsis in the management of wounds has completely revolutionized surgical practice, and the old fatal types of pyemia and septicemia, which depended upon a primary septic lymphophlebitis, have now practically vanished. Septic and pyogenic phlebitis still remain as consequences of accidental wound contaminations and as a penalty for the neglect of surgical cleanliness. Prophylactic measures by the use of internal remedies which diminish the coagulability of the blood, such as Wright's citric acid treatment, are recommended for the prevention of thrombosis in the terminal stage of the great infections (typhoid, typhus, the exanthemata, etc.),

in which the tendency to coagulation is increased. This mode of treatment will always be of very restricted value, because it does not counteract the primary cause of the thrombus formation, which lies in some form of toxemia of combined exogenic and endogenic origin.

An effective or abortive treatment should consist, theoretically, in the prompt administration of a reliable antitoxin of a polyvalent type, which would at once neutralize or inhibit the further growth of the bacteria in the veins or elsewhere. The anticipations based on the success of diphtheria antitoxin have not as yet been realized in connection with the streptococcal and staphylococcal infections, in spite of the efforts made to procure reliable antitoxic sera. But it is only in this direction that we may expect to prevent, abort, or arrest the progress of those infections which are the cause of the most fatal types of thrombophlebitis.

The *curative treatment* may be constitutional or symptomatic, local or surgical.

The **constitutional treatment** is directed to the removal of the general cause, if possible, as in the gouty, rheumatic, syphilitic, and chlorotic cases; beyond this, there is no specific treatment The antistreptococcal and staphylococcal sera are

usually prescribed in the diffuse septic forms, but thus far more as a forlorn hope than with the expectation of accomplishing any definite results. The same unfavorable experience has attended the administration of the silver salts (Crede) by inunction or intravenous injection of collargolum. Nothing can be said in special favor of the intravenous injection of antiseptic substances (formalin solutions, nitrate of silver, or bichloride of mercury), all of which would tend to do harm in the treatment of phlebitis by a decided hemolytic action which would favor thrombus formation without compensatory bactericidal action.

The **symptomatic treatment,** on the other hand, is always indicated to diminish pain, to support, and strengthen the circulation, and to favor elimination. The main reliance is to be placed upon the *local treatment,* combined with good nursing, appropriate food, and moderate stimulation.

The **local treatment** is summed up in the following indications: (1) Immobilization and absolute rest of the affected limb; (2) elevated position of the foot of the bed or of the limb to favor the drainage of the venous current toward the trunk. The limb should be covered with cotton batting and bandaged over a padded gutter-splint of card-

board, extending from the foot to the thigh, to immobilize the knee. In the superficial inflammations with much redness and heat an even layer of any of the kaolin mixtures may be applied between thin layers of gauze, like an antiseptic poultice, over the entire extremity, and especially over the inflamed parts. A saturated watery solution of 25 per cent. ichthyol, painted over the entire surface, will also prove decidedly beneficial in cases complicated with lymphangitis. Unguentum Crede, mercurial ointment, and so-called local resolvent lotions have been recommended and applied, but none of these can compare in their beneficial effect with kaolin poultices, with or without ichthyol, or the liberal application of broad compresses thoroughly saturated with a weak lead and opium lotion, which acts not only as a local astringent, but as a marked sedative. Immobilization and rest should be maintained for a month or more.

From this extreme conservatism the pendulum of professional opinion is now swinging in the opposite direction, i.e., toward applying early passive movements when the signs of the acute infection have passed, as shown by normal temperature, subsidence of the edema, and softening of the hard venous cords. At this stage I recommend gentle

passive movements of the joints and tentative surface stroking (effleurage) at a distance from the lines of infection, in order to improve the nutrition of the limb and activate the sluggish circulation. Massage is dangerous, and should not be attempted until months after complete convalescence has been established.

The **operative treatment of acute septic thrombophlebitis** has in view three indications, and the procedures adopted must vary according to these, viz., (1) Ligation of the vein between the thrombotic focus and the uninfected vein on the cardiac side, in order to obstruct the further advance of the infection, and thus prevent the entrance of septic emboli into the circulation. (2) Removal of the primary focus of infection, either by (a) direct incision into the veins, evacuation of the septic thrombus and drainage; or (b) by the extirpation of the infected veins with the contained clot and septic contents.

This is known as Mueller's operation and a secondary suture as it is called is put in at this time and the wound packed. After a few days the dressing is removed and the wound closed by the tying of the silk ligatures.

These principles have been extensively applied to

the treatment of phlebitis already complicated by pyemia and septicemia, or in which these dreaded complications were anticipated. The older surgeons who had to contend with septic phlebitis much more frequently and disastrously than those of the modern period, fully realized the advantages of protecting the circulation by putting obstacles in the way of infection; but the non-aseptic methods at their command often aggravated the evil by adding further infection as a result of their procedures. In this way the practice of prophylactic ligation, thrombectomy, and phlebectomy in septic phlebitis fell into disrepute, and it was only in the Listerian period that surgical intervention again boldly asserted itself, and, in contemporary practice, has in this field gained some of its most brilliant achievements.

THE OPERATIVE TREATMENT OF VARICOSE VEINS.

With the perfected methods of aseptic technic, the surgical treatment of varix has become one of the most valued acquisitions to modern surgery. C. H. Mayo has reported a series of 185 successful operations without a death; and in the Johns Hopkins Hospital 125 operations have been recorded with one case of pulmonary embolism which recovered. The danger of embolism still exists, but the emboli are non-septic and are of minor significance.

The modern operative treatment of varicose veins is based upon four fundamental procedures: (1) The open ligature of the varicose trunks; (2) the linear section of the varicose trunks between ligatures, with or without the inclusion of the collateral tracts by circumferential incisions; (3) the open resection of the varicose trunks and secondary tributaries; (4) the subcutaneous resection of the venous trunks in their totality.

The principles which underlie these operations are: (1) To arrest the hemodynamic reflux of the venous column into the superficial veins (long and short saphenous), when the valves are incom-

petent and the varicose state is associated with or consequent upon a progressive increase in the intravenous tension. (2) To force the superficial venous circulation from the unsupported subcutaneous veins into the deep muscular trunks when these are not obstructed by previous disease. (3) To remove permanently the diseased venous tracts which have become functionless and dangerous to the organism from the effects of disease or infection. (4) To prevent the direct entrance of blood into the superficial varices (already incompetent from the functionless valves) from the deep intramuscular trunks by the obliteration of the anastomotic branches while extirpating the dilated superficial veins.

The operations which aim at the obliteration of the venous trunks with the ligature, in order to support the venous column and prevent the venous reflux, may be regarded in a large measure as palliative, and those which extirpate these trunks are classed as radical, though this designation does not necessarily imply that the varicose state is cured, particularly as in a certain percentage of operations the veins are reproduced and relapse occurs.

Trendelenburg's Operation. The obliterative

ligature of the saphenous was systematized and applied on the basis of its preventing the venous reflux by Trendelenburg in 1890, who explained the effects of hydrodynamic pressure of the blood column upon the vessel. Trendelenburg's first operation consisted in the division of the long saphenous at the point of junction of the lower with the middle third of the thigh. He subsequently modified this procedure by placing two more ligatures on the saphenous, one above the level of the internal condyle and the other below the knee. Trendelenburg's operation is very simple in its technic and is usually performed under local anesthesia. The long saphenous is approached through a short incision at right angles to its course, and divided between ligatures near the saphenous opening. Each end of the divided vein is doubly ligated with fine chromic catgut or fine aseptic silk. The following experiment will show whether this operation is indicated or not: The patient is asked to lie down, and one assistant grasps the leg at the heel and raises the extremity so as to empty the internal saphenous vein. Another assistant makes firm pressure upon the vein at the upper third of the thigh, and the patient is next asked to stand, firm pressure being maintained. As soon as the patient

stands the pressure is released above, and one notices whether the vein will fill up at once or not with blood. If the vein refills, this shows that the valves are incompetent and the operation of resection of the internal saphenous vein at the junction of the upper and middle third is indicated. If the above phenomenon does not occur, this operation is contra-indicated.

Schede's Operation. Another procedure is known as the Schede operation and its modifications. The linear division of veins between ligatures is accomplished by circumferential incisions (circumcision of limbs), and has been associated with the name of Schede, who first described it in 1877. A partial or complete circular incision is made in the upper third of the leg, which divides all the superficial veins, including the long and short saphenous, down to the deep tibial aponeurosis. If the circumcision is partial, it should divide at least all the veins in the anterior, internal, and posterior aspects.

Recently Friedel has proposed in severe cases to encircle the leg with a deep continuous spiral incision extending completely through the skin to the fascia from the ankle to the knee. There should be from six to twelve turns, according to the severity of the

case, and after tying the vessels, the wound must be kept open by packing, so as to obtain as deep and firm a cicatrix as possible. Upon this depends the success of the operation. If an ulcer be present, it must be within the area of the spiral and not below it. The principal objections to this method are the protracted convalescence and the considerable deformity.

MORESCHI OPERATION.

The same principle is applied by Moreschi in the treatment of varicose ulcers. He makes two circumferential incisions through the skin to the aponeuroses, the first 4 cm. above the ulcer, the other 1 cm. above the malleoli. The ulcerated area is included between these incisions. The peculiarity of Moreschi's operation is that the skin in the immediate vicinity of the ulcer and between the two parallel incisions is completely undermined and detached by subcutaneous dissection with a knife or scissors, with a view of destroying the varices and their tributaries over a large area within the line of the cross-section. Pizzono also ligates the saphenous at the root of the limb in applying Moreschi's procedure to prevent or diminish the dangers of embolism, which has already proved

fatal in one case after this operation. Rindfleisch (1907) makes multiple spiral incisions around the limb and packs the wound to obtain deep scars.

Resection. This may be partial or complete. The partial consists in the removal of one or more sections of the varicose trunk by a series of interrupted incisions, as suggested by Madelung in 1884, and systematized by Schwartz, in France, since 1888. In the complete, the whole of the main trunk of both saphenæ is removed. This has been recently systematized by Terrier and Alglave, who have practiced and advocated the most extensive resections by continuous open incisions thus far described. They call special attention to the influence of direct anastomotic branches which reach the surface veins through perforations in the deeper aponeuroses, and which supply the superficial varices with the greatest amount of blood. They advocate extensive extirpations of the main trunks and of their tributaries in order to intercept these deep branches, which are found most numerously near the mouth of the saphenous and Scarpa's triangle and the middle of the thigh. They report 21 cases successfully treated by extirpation of both the internal and external saphenous throughout their whole length, with or without inclusion of the over-

lying skin, according to whether this is involved in the varicose process or not. The combined total resection of the saphenous trunks is occasionally assisted by circumcision on the Moreschi plan when the case is complicated with varicose ulcer. Madelung's operation has also been modified by Ledderhose, who, in addition to the extirpation of the veins, makes a series of longitudinal incisions along the inner aspect of the leg from the knee to the malleolus, by which he expects to intercept and obliterate all the tributaries lying between the knee and the ankle.

Open Section and Thrombectomy. Kraemer recommends the systematic incision and evacuation of all thrombotic varices forming large irregular cavernous plexuses. He opens the venous cavities and tortuous veins longitudinally and carefully wipes out the clot and allows the wound to come together by simple approximation and bandaging. He has operated fifty times by this procedure, with great relief to the patients and rapid obliteration of the varicose area.

The saphenous veins may be resected in their totality by continuous open incisions or by a series of short, interrupted, "buttonhole" incisions made along the length of the saphenous tracts, from the

groin to the ankle and from the knee to the ankle. These are the so-called subcutaneous resections, and the methods by which this is done vary with different operators. Cassatti describes a method of tearing out the vein after mobilizing the main trunk by subcutaneous traction and dissection. Narath extirpates the entire saphenous through a series of small interrupted incisions, which permit the vein to be isolated and detached from its surroundings by traction and subcutaneous manipulations. The incisions are made at intervals of 10, 15, and 20 cm., the vein being isolated and brought out by hemostats through each one of the openings successively without dividing it, until the vessel has been completely loosened from its tributaries throughout its length, when it is extracted whole from the groin to the ankle after ligation near the femoral incision. The incisions are not over 1 cm. in length and are closed with a single suture. He is very well satisfied with this procedure, which he has practiced successfully for many years.

Narath's method has been much simplified by the operation of C. H. Mayo, which has met with general approval and adoption in preference to the extensive lacerations required for the older methods.

Mayo excises the long saphenous vein as follows:

Expose and isolate the vein near the saphenous opening. Divide the vein between ligatures. Seize the peripheral portion of the vein with a hemostat. Pass the end of the vein through the loop of Mayo's dissector. Guided by the vein push the dissector under the skin down to a point near the knee; cut through the skin over the end of the dissector; clamp the vein, pull it out through the wound, ligate and excise the loose portion. If the dissector is obstructed in its work by adhesions around the vein, pass the closed forceps alongside it, and when the adhesions are reached open the blades of the forceps slightly, this usually overcomes the trouble and the dissector can complete the work. In the same manner remove subcutaneously as many other veins as may be necessary. The dissection should be from above downwards to avoid the dangers of detaching thrombi and throwing them into the circulation.

A year later Keller of the U. S. Army described the method of avulsion by inversion, classic in its simplicity and ease of performance. Finally Babcock, in an excellent resume of indications for operative interference with descriptions of various procedures, described an operation which would seem to be the last word in methods of total extirpation

of the saphenous system. Instead of interrupting the avulsion at the knee, in suitable cases, he removes, at one sweep, the entire system down to the ankle by means of a modified bougie-a-boule, 28 inches in length. Though I have not tried the operation, I can readily assent to its feasibility and thoroughness. However, it fails of that feature which appeals to me in the Keller operation, namely, that the bed from which the vein is removed is untouched by instruments save at the point of entry and exit. This is a theoretical objection, inasmuch as the only possible agent of infection is the enlargement at the end of the bougie; but it is a real one none the less, and it is reasonable to remove, where possible, even the theoretical possibility of infection along the subcutaneous tunnel left by such operations.

Of course, these extensive avulsions *en bloc* apply only to the simple dilatations. Where varices exist, i. e., windings of the vessel back on itself with sacculations, open dissection is the only resort.

The ease of removal by Keller's or Babcock's method might provide a useful modification of Trendelenburg's operation, in that a foot of the vein may be removed with almost as little difficulty as an inch, thus avoiding recurrence through

dilatation of the collaterals. Recently I removed the saphenous system of a man operated upon one year before by ligation and division, on both sides, of the saphenous trunk, which measure had been followed by complete restoration of the offending blood column through collateral circulation. There was no tortuosity of the vein nor adhesion of the skin. The case was, therefore, an ideal one for avulsion. On one side, owing to inexperience, four incisions were required and considerable fumbling, as the vein was twice torn at the attachment to the probe, and as I failed to cut the posterior femoral branch. On the other side the entire vein, from 3 inches below the saphe-no-femoral junction to 4 inches above the internal malleolus, was readily removed through three small transverse incisions. It might, as in Babcock's cases, have been done through two, save that this requires an inconvenient length of probe, i. e., about two and one-half feet. The usual ecchymosis appeared along the route of the vein, but otherwise no sequelæ, and the symptoms were relieved.

The operation is fundamentally as follows: The vein is cut down on in two places at a convenient distance apart. A probe with an eye is

passed through the lumen of the vein and attached by the eye to the cut end of the vein. The probe is now withdrawn in the direction of the unattached end, so that the vein is withdrawn from its bed through its own lumen. It is unnecessary for the assistant to start the inversion with forceps, as the attachment of the vein to the surrounding connective tissue affords a natural means to this end.

An objection to a probe with an eye is that the vein is prone to slip off and draw, not from the probe, but from the ligature threaded through it. A probe with a groove around it, over which a silk ligature is tied, makes a firm attachment.

In experimenting on a saphenous trunk after removal, the vein on traction invariably tore through elsewhere than at the ligature, so the attachment was at least as strong as the vein.

In a letter appended to Keller's article, A. Weeks suggested inserting the probe through the vein from the first incision, as a finder over the end of which to make the second incision, thus avoiding a search for the vein at the point where the probe is to emerge. The suggestion, however, involved entering at the knee and passing upward with the blood current, an obviously questionable procedure at once avoided by passing from above downward against

the current, after the vein has been tied off from the general circulation. The act has this additional advantage that the larger and stronger end of the vein is drawn against the weaker.

I want to emphasize the advantage of cutting subcutaneously any branches offering sufficient resistance to endanger the continuity of the main trunk. This additional source of infection is, of course, immediately dragged into the disappearing lumen and amounts practically to division of the posterior mid-femoral branch only, which is easily found, as Keller pointed out, by the puckering of the skin over it or by traction.

In cases of long standing, it is usually impossible to remove the vein below the knee by inversion, for there it becomes tortuous and adherent to the skin, calling for dissection. The main trunk of the varicosities over the posterior and peroneal may be removed through a transverse incision about 2 inches below the first bifurcation.

Moderately firm pressure applied over the stump of the saphenous by a "figure of eight" around the pelvis keeps the stump free from blood until the intima has united and the danger of embolus is passed.

Relapse is more likely to follow the single linear division of the veins than after the more thorough

extirpations. Nevertheless, relapse will occur even after extensive resection. The causes of relapses are: Secondary dilatation of small superficial tributaries of the extirpated or ligated vein, which enlarge and connect with the deep muscular veins through direct anastomotic branches; (2) the re-establishment of direct end-to-end communication through to the scar, especially after ligation; (3) the regeneration of the veins believed at one time to be impossible, but since proved to be of frequent occurrence.

After an operation as the one just described it is advisable to keep the patient in bed at least three weeks, and at the end of that time gentle massage with active and passive motion is resorted to. At the end of the fifth or sixth week the patient is allowed to resume work.

He should also wear an elastic stocking or bandage for quite some time, or a leg corset. This is carefully made from a cast of the leg, the material used being washable linen or silk and is provided with light stays to prevent sagging. This corset can also be used in cases where the patients refuse an operation as this provides a way to support the veins in addition to the other means previously mentioned.

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